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Clinical Obstetrics

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SEVENTH REVISED EDITION

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PREFACE TO THE SEVENTH EDITION

In bringing out the seventh edition of this book on Clinical Obstetrics under our joint authorship, advantage has been taken of the opportunity to revise the book thoroughly, incorporating the latest advances and methods of treatment for several conditions. In the light of these developments, it has been found necessary to delete some portions particularly those relating to the different categories of Contracted Pelvis and to the methods of treatment adopted.

The latest advances to which we have referred in an earlier edition, Blood Transfusion, the role of antibiotics, improved methods of Anaesthesiology, the greater appreciation of antenatal care, have made it possible to reduce very materially maternal risks and to lessen or completely eliminate any destructive operation on the foetus. Operative obstetrics have now been made safe and it is now for the pregnant woman to be made safe for obstetric procedures by efficient antenatal care.

In spite of all these developments the maternal and perinatal mortality rates continue to be high by modern standards in developing countries. This is mainly due to socio-economic factors which impose severe restrictions on the quantity and quality of obstetric service. The emphasis throughout the book is on the clinical and practical aspects of obstetrics rather than on its academic and scientific aspects. This approach is necessitated by the existing conditions under which obstetrics have to be practised in this country.

We are thankful to Dr. V. Rajagopalan, F.F.A.R.C.S., who has revised his chapter on Anaesthesiology in relation to pregnancy and parturition.

Our thanks are once more due to Messrs. Orient Longman who have consistently taken a lively interest in the publication of this book and have made it available to students and practitioners in a relatively short time.

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SECTION I

ANATOMY AND PHYSIOLOGY

CHAPTER I

THE PELVIS

THE pelvis is important from the obstetric point of view, as it forms the canal through which the fœtus has to pass. It may be divided into an upper part, the pelvis major or false pelvis, and a lower part, the pelvis minor or true pelvis, by the linea terminalis, which is formed by the upper border of the first sacral vertebra, the arcuate line of the ilium and the pectineal line of the pubis. The pelvis major, or the upper part of the pelvis, is the expanded portion above this line, while the true pelvis lies below and behind the linea terminalis. This is the part of the pelvis chiefly concerned in child-birth.

The true pelvis may be divided into an inlet, a cavity and an outlet. At the inlet is the brim of the pelvis, which is the oval space corresponding to the plane of the superior strait. The circumference of the inlet is formed by the anterior margin of the base of the sacrum behind, the arcuate and pectineal lines at the sides, and the continuation of the pectineal line into the tubercle and the crest of the pubis in front. The outlet is very irregular in outline. It is bounded behind by the tip of the coccyx, at the sides by the ischial tuberosities and in front by the public arch, which is formed by the inferior rami of the ischium and the pubis as these converge from either side towards the pubic symphysis. This outlet is incomplete at the sides between the ischial tuberosity and the coccyx and the sacrum, and here the wide interval is bridged across by the sacro-spinous and the sacro-

tuberous ligaments. The cavity is cylindrical in form and extends from the brim or inlet above to the outlet below.

Covering the bone and the ligaments are a series of broad and thick muscles and their investing fasciae, so that the form of the canal is considerably altered. On each side are the Piriformis and the Coccygeus muscles posteriorly, the Obturator internus laterally and the Levatores ani inferiorly. The Levatores ani and the Coccygei form a musculo-aponeurotic partition called the pelvic diaphragm, separating the pelvis above from the perineum and vulva below. There are three orifices, the urinary meatus, the genital outlet and the anus, which pierce this diaphragm.

The Diameters of the Pelvis. The measurements of the bony pelvis are important, as they furnish the obstetrician with the dimensions of the somewhat rigid bony canal through which the foetus has to pass. The actual diameters in the living specimen are, however, less, owing to the fact that the bony surfaces are covered with soft parts and muscles which diminish to a certain extent the measurements obtained in the skeleton.

The *external measurements* which are usually taken are :—

(1) The *interspinous diameter*, which is the distance between the outer lips of the antero-superior iliac spines, measuring about 10 ins. (25 cm.).

(2) The *intercristal diameter*, which is the distance between the outer lips of the iliac crests at the widest part, measuring about 10½ to 11 ins. (27.5 cm.).

(3) The *external conjugate* or *diameter of Baudelocque* is the distance between the depression just below the spinous process of the last lumbar vertebra and the most prominent point on the antero-superior surface of the symphysis pubis in the mid-line—about 8 ins. (20 cm.).

(4) The *inter-trochanteric diameter* is the maximum width between the greater trochanters measuring 12½ ins. (31 cm.).

These external measurements afford by no means a correct estimation of the size of the true pelvis, but they help in the majority of cases to give a fairly definite idea of the size and the general configuration of the pelvis.

So far as the true pelvis is concerned, the diameters are generally taken at different planes. The planes usually chosen for this purpose are :—

- (1) The plane of the pelvic inlet.
- (2) The plane of the pelvic outlet.
- (3) The plane of the greatest pelvic dimensions in the cavity.
- (4) The plane of the least pelvic dimensions in the cavity.

The Pelvic Inlet. The diameters of the pelvic inlet are of great obstetrical importance. The chief of these diameters is the *obstetrical conjugate*. This diameter represents the distance between the sacral



FIG. 1.—Diameters of the inlet and outlet of the female pelvis.

promontory and the nearest point on the posterior surface of the symphysis pubis. It measures about 4 ins. (10 cm.).

The *anatomical conjugate* or *conjugate vera* (11 cm.) is the distance between the sacral promontory and the upper portion of the inner surface of the symphysis pubis; while the *diagonal conjugate* (12.5 cm.) is the distance from the promontory of the sacrum to the apex of the pubic arch. The diagonal conjugate is generally of great value in estimating the size of the true conjugate, and this is obtained by subtracting about $\frac{1}{4}$ in. (2 cm.) from the diagonal conjugate, thus allowing for the inclination, thickness and height of the symphysis pubis.

Other diameters that may be taken at the superior strait are:—

(a) The *transverse diameter*, which represents the greatest width in this plane. It is the distance between the widest apart points on the linea terminalis and measures about $5\frac{1}{2}$ ins. (13.5 cm.) normally.

(b) The *oblique diameters, right and left*. They run from the sacro-iliac joint of one side to the ilio-pectineal eminence of the opposite side and they are termed right and left, or first and second—



FIG. 2.—Sagittal section of the bony pelvis showing the curve of Carus and the antero-posterior diameters at the inlet, Cavity and outlet.

Note the changing position of the coccyx during labour.

the former being from the right sacro-iliac joint and the latter from the left. These measure about 5 ins. (12.75 cm.).

The Plane of the Outlet. Here, two diameters are taken—the antero-posterior and the transverse.

The *antero-posterior diameter* extends from the apex of the pubic arch to the tip of the coccyx and it measures about $4\frac{1}{2}$ to 5 inches. The coccyx, however, being movable, permits of an increase in the diameter of nearly half to one inch (2 to 2.5 cm.), so that the length of the diameter increases from 5 to $5\frac{1}{2}$ ins. when the coccyx is displaced backwards during delivery.

The *transverse diameter* is the distance between the inner surfaces of the ischial tuberosities and measures about $4\frac{1}{2}$ ins. (11 cm.).

In **the cavity** there are several planes, but the chief planes which may be reckoned with for purposes of obstetrical consideration are the planes of the greatest and least pelvic dimensions.

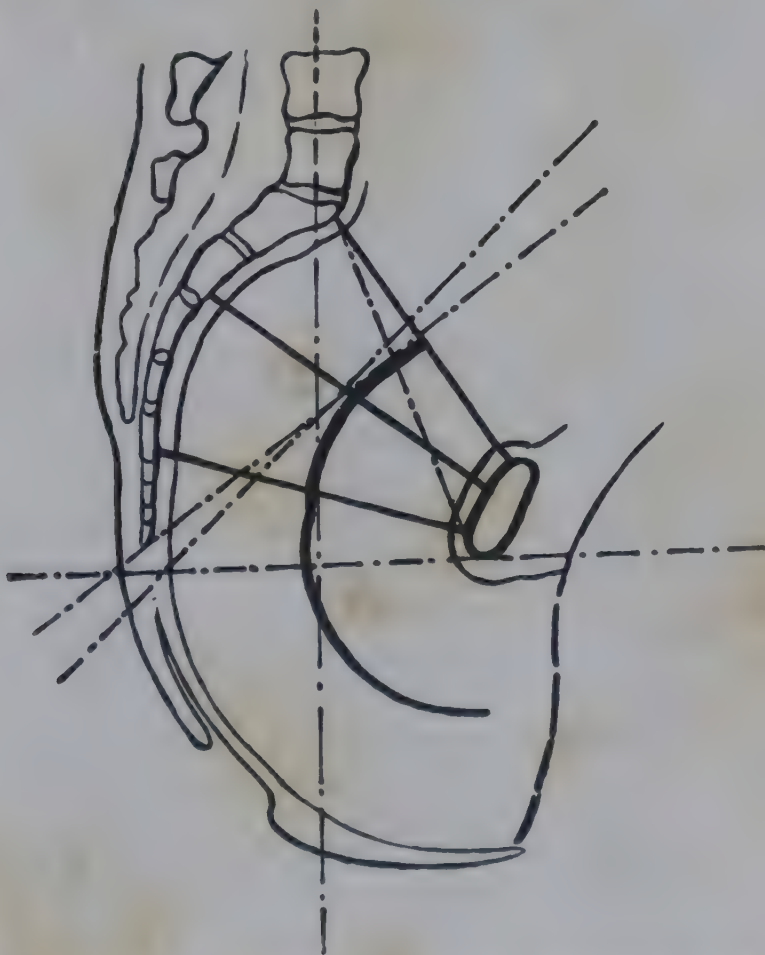


FIG. 3.—Sagittal section of the pelvis showing the planes with their axes at different levels.

The *plane of the greatest pelvic dimensions* passes through the junction of the second and third sacral vertebræ, and laterally through the ischial bones over the middle of the acetabulum. It is nearly circular and its antero-posterior diameter measures 5 ins. (12.5 cm.) while its transverse diameter measures $5\frac{1}{4}$ ins. (12.75 cm.).

The *plane of the least pelvic dimensions* extends through the lower margin of the symphysis pubis, the tip of the sacrum and the ischial

spines. The antero-posterior diameter measures about $4\frac{1}{2}$ ins. (11.5 cm.), while the transverse diameter measures about 4 ins. (10.5 cm.).

Pelvic measurements may however vary within a limited degree in different countries. The measurements given above are the average of European and American women. In Southern India, however, the average measurements are $\frac{3}{4}$ to 1 inch (2 to 2.5 cm.) shorter in all diameters and this should be borne in mind in judging whether a pelvis is contracted or not.

The Posterior Sagittal diameter is that part of the conjugate lying posterior to the transverse diameter. It gives a good idea of the space available in the posterior segment of the pelvis and is of great importance in labour. The various diameters at the different levels are given below : (Indian)

		A.P.	Transverse	Pos. Sagittal
Inlet	.. ..	10.5 to 11.25 cm.	12.5 to 13.75 cm.	4.25 to 5 cm.
Cavity	.. ..	11.25 cm.	9.25 to 10 cm.	5 to 6.25 cm.
Outlet	.. ..	12.5 to 13.75 cm.	10 to 10.75 cm.	6.25 to 7.5 cm.

The measurements are given in centimetres. They are the average and those of the midcavity represent the measurements at the plane of the least pelvic dimensions.

The Joints of the Pelvis. The *Sacro-iliac joint* is a synovial joint between the auricular surfaces of the sacrum and the ilium. In the adult male, a large number of short but strong bundles of fibres enter into the constitution of the sacro-iliac ligaments, and as a result only a small amount of antero-posterior rotatory movement is possible. In the female, after puberty, the range is much greater and it is increased temporarily in the later months of pregnancy.

The Pubic Symphysis. The pubic bones are united to each other by a superior and an inferior pubic ligament and by an inter-pubic disc of fibro-cartilage.

During pregnancy the pelvic joints and ligaments are relaxed and therefore more mobile. When the fœtus is being expelled, the force is applied to the front of the sacrum. Upward dislocation is prevented by the interlocking mechanism of the middle segment of the sacrum. As the fœtal head passes the anterior segment, the antero-posterior diameter of the pelvic inlet is slightly enlarged, and when the head reaches low the posterior part of the sacrum is pressed upwards against the resistance of its wedge, the movement being rendered possible only by the laxity of the joints and the stretching of the sacro-tuberosus and sacro-spinous ligaments.

Difference between Male and Female Pelvis. The pelvis presents marked differences in the two sexes. In the male the pelvic bones are stronger, heavier and rougher than in the female. The muscular impressions are more marked in the male than

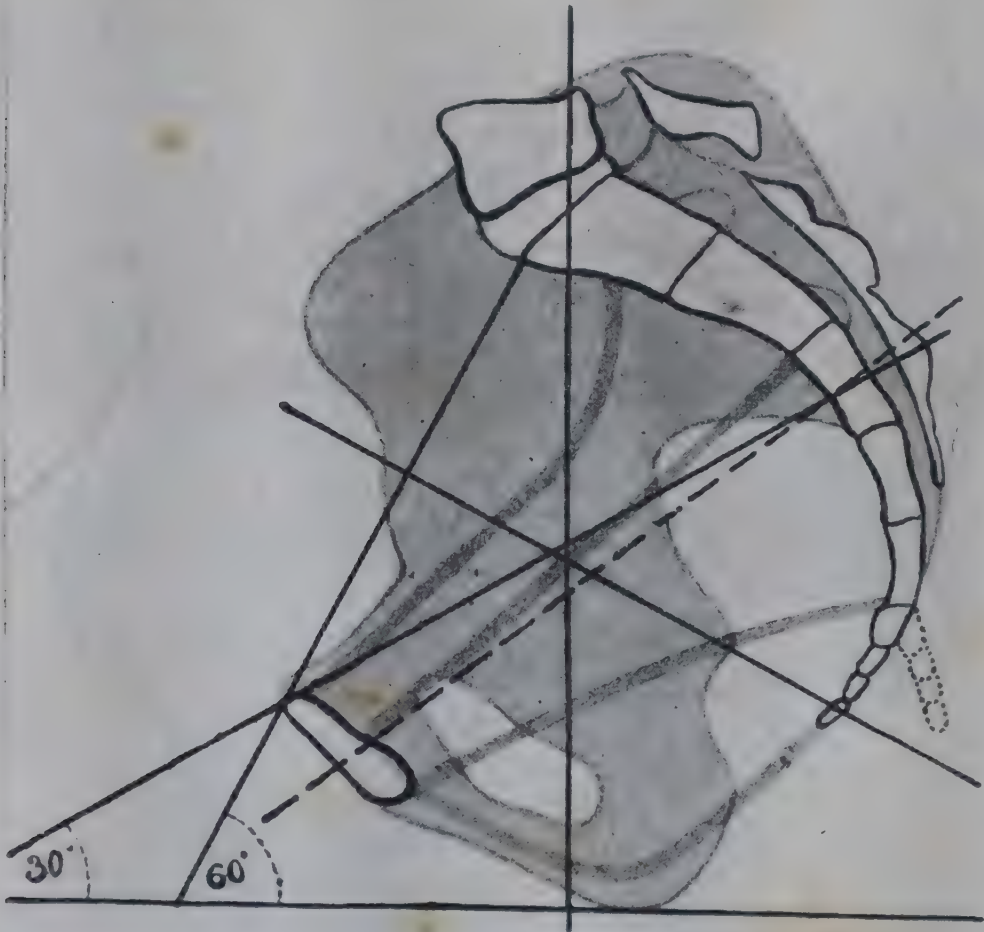


FIG. 4.—Sagittal section of the pelvis showing the inclination of the pelvis.

in the female, while the iliac fossæ are shallower in the latter. The ischial spines and the tuberosities are more widely separated in the female. The pubic arch is more acute (70° to 75°) in the male, whereas in the female it is more arched (90° to 100°). The curves in the sacrum, both lateral and vertical, are more marked in the female than in the male. The pelvic inlet is rounder in the female and the diameters are generally longer than in the male. The cavity is broad and round in the female, while in the male it is more conical and funnel-shaped. The outlet in the female is much larger on account of the recession of the lower end of the sacrum and the coccyx and the greater distance between ischial tuberosities.

Caldwell and Moloy's Classification. Caldwell and Moloy have, on the basis of x-ray studies, attempted a morphological classification of the pelvis. This takes into consideration the anatomical variations in the pelvic architecture presumably caused by racial,

sexual or other complex inherited influences rather than by any pathological bony changes. According to this classification, four parent types of pelvic shape could be recognized, viz.:—

(1) The Gynæcoid type which is the type displaying the accepted female sex characteristics.

(2) The Android type which resembles more the average male pelvis.

(3) The Anthropoid type which resembles the pelvic form of the great apes, and

(4) The Platypelloid type characterised by a broad flat form similar to the flat type of pelvis.

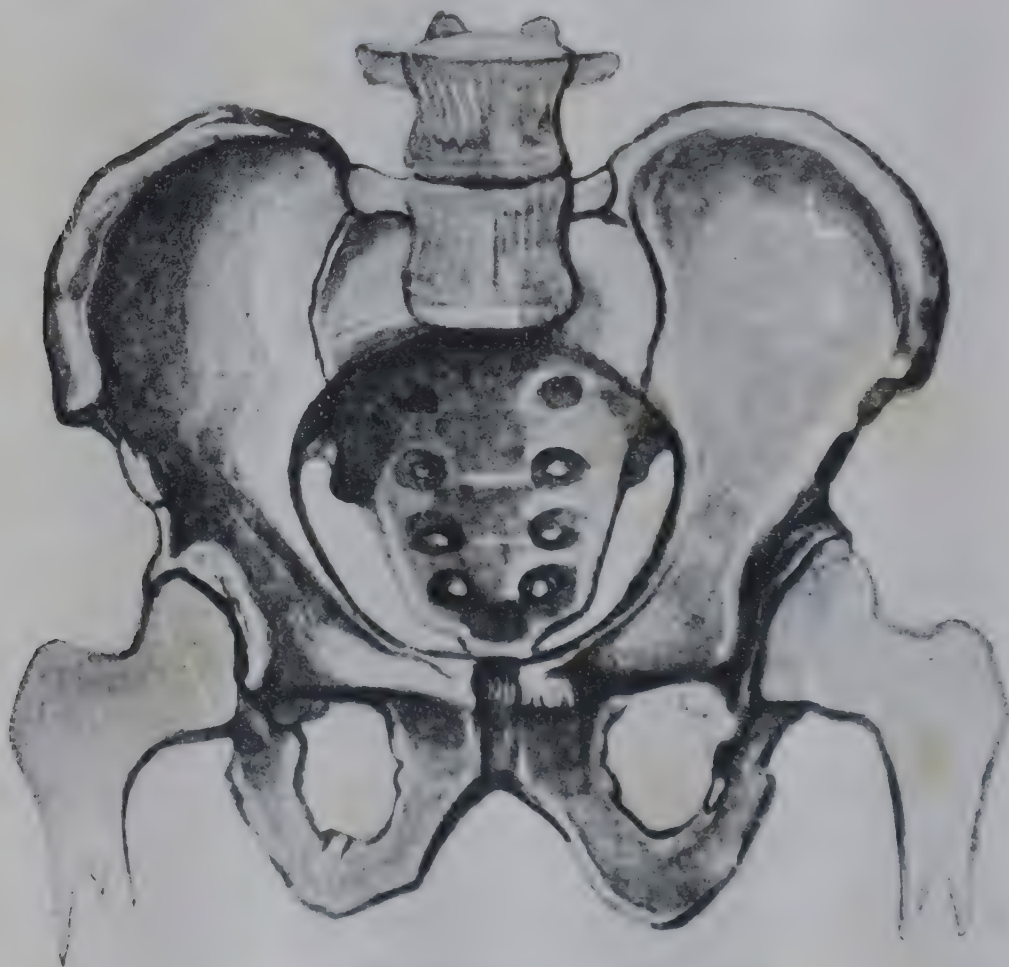


FIG. 5.—Configuration of the male pelvis.

There may, however, be intermingling of these types when a posterior segment of one of the four parent types is associated with the forepelvis of another. A detailed classification and study of these types of pelvis will be given in a later chapter. The great importance of this recent work lies in the fact that it stresses the need for recognition of certain general types of pelvis which permit of distinct varieties of mechanism in labour.

THE FEMALE ORGANS OF GENERATION

The External Genital Organs. The external generative organs consist of the mons veneris, the labia majora and minora, the clitoris, the vestibule, the hymen and vaginal orifice, the external urethral meatus and the perineum. All these structures are generally included in the term vulva.

The *mons veneris* is the pad of fat lying in front of the pubis, and in the adult female the skin over it is covered by a growth of hair.

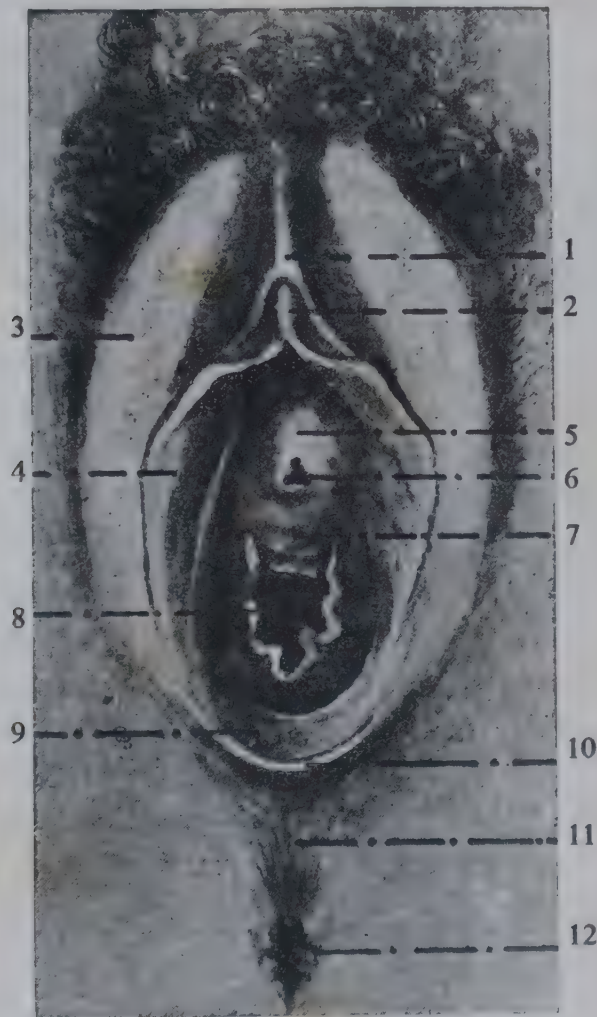


FIG. 6.—External genitalia.

- | | | |
|------------------|---------------------------|-----------------------|
| 1. Prepuce. | 5. Vestibule. | 9. Fossa navicularis. |
| 2. Clitoris. | 6. Urinary meatus. | 10. Fourchette. |
| 3. Labium majus. | 7. Anterior vaginal wall. | 11. Perineum. |
| 4. Labium minus. | 8. Vagina. | 12. Anus. |

The *labia majora* are the two elongated folds of skin projecting downwards and backwards from the mons veneris. They meet

in front in the anterior commissure and posteriorly in the posterior commissure in front of the anus.

The *labia minora* are exposed only when the labia majora are separated. They are two thin folds of skin, one on each side, just within the labia majora. The lower portions of the labia minora fuse across the middle line to form a fold known as the fourchette, which is usually lacerated during child-birth. Between the fourchette and the vaginal orifice is a boat-like depression, the fossa navicularis.

The *clitoris* is situated in the most anterior portion of the vulva and projects between the two folds of the labia minora. This corresponds to the penis in the male.

The *vestibule* is the triangular surface which extends from the clitoris above, to the anterior margin of the hymen below, and laterally to the labia minora. At the centre of the vestibule is the opening of the urethra. The vestibule is generally concealed by the labia in the natural condition.

The *Hymen*. This is an incomplete septum of mucous membrane which closes the vaginal orifice. In the virgin the aperture in it is usually a small longitudinal slit, running from behind forwards. The membrane may vary in shape, but is usually circular or somewhat crescentic. The hymen is usually ruptured at the consummation of marriage, and is therefore considered one of the signs of virginity when it is intact. This is not, however, absolutely certain evidence of virginity. At child-birth the hymen is extensively lacerated, and is later represented by a large number of cicatrised nodules of varying sizes, called the *carunculæ myrtiformes*.

The *perineum* is the wedge-shaped area between the lower end of the posterior wall of the vagina and the anterior anal wall.

The *Bartholin's* glands are a pair of small globular structures, situated one on either side of the vaginal orifice and covered by the posterior end of the bulb of the vestibule. They are compound racemose glands and lead into a narrow duct which opens below the hymen on the inner surface of the labium minus near its posterior end.

The Internal Genital Organs. These are the vagina, uterus, Fallopian tubes and the ovaries.

The Vagina. This is a tube extending from the vulva outside to the uterus, and is situated between the bladder in front and the rectum behind. It is directed upwards and backwards and is slightly curved posteriorly. The vaginal canal is a transverse or H-shaped slit with the lower end somewhat narrower than the upper end. The cervix dips into the vaginal canal, and the vault of the vagina which surrounds the cervix consists of four pouches or fornices: the anterior fornix in close

relation with the bladder ; the posterior fornix, which is a *cul-de-sac* in relation with the pouch of Douglas and the rectum ; and the right and left fornices, which are in close relation with the ureter and uterine artery of the side.

Anteriorly, the vagina is in relation with the bladder and the urethra. A septum intervenes which contains a considerable amount of musculo-fascial tissue. Laterally, the vagina is supported by the free edges of the Levatores ani muscles. Posteriorly, in its upper third, the vagina is related to the pouch of Douglas and is therefore in close contact with the peritoneal cavity, being separated from it only by a thin septum formed by the vaginal wall and the peritoneum. The lower portion of the vagina is in relation with the rectum and perineal body.

The vagina is lined by stratified squamous epithelium.

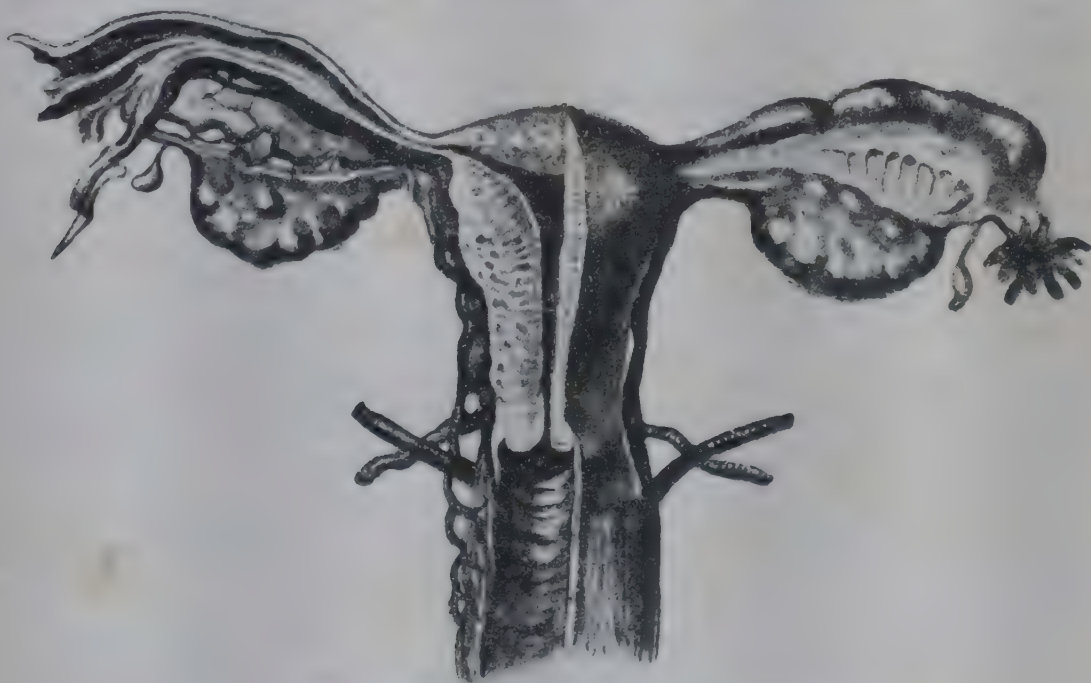


FIG. 7.—The uterus and its appendages (posterior view).

Section of the left half shows the cavity of the uterus and lumen of the Fallopian tube.

The Uterus. The uterus is a hollow organ situated in the pelvis between the bladder in front and the rectum behind. It is pear-shaped in the unimpregnated condition and is partially covered by peritoneum and lined by a mucous membrane, the endometrium. It consists of two unequal parts, the corpus or body and the neck or cervix. The Fallopian tubes come off from either side of the uterus at the junction of the superior and lateral margins. The portion of the uterus above the level of the insertions of the Fallopian tubes is known as the fundus of the uterus. It is convex or dome-shaped and is directly continuous with the rest of the

body. The cavity of the uterus is triangular in shape with the base upwards, and the apex situated at the junction of the body with the cervix. In the non-gravid condition the length of the cavity is about 3.5-5 cms. The endometrium, or the lining membrane, is composed of a cellular stroma of embryonic cells in which lie simple tubular glands and is covered by a columnar ciliated epithelium.

Corpus Uteri. The wall of the uterine body is composed of three layers, the serous, muscular and mucous. The serous layer is formed by the peritoneum which covers the anterior two-thirds and the whole of the posterior surface of the uterus. The mucous layer, known as the endometrium, is attached directly to the muscular layer. There are a large number of small tubular glands—the uterine glands—projecting down from the surface of the endometrium.

The greater part of the uterus is made up of non-striated muscle united by connective tissue in which are found elastic fibres. The body of the uterus along with the cervix undergoes marked changes in pregnancy and during labour.

The Cervix Uteri. This is the portion of the uterus which lies below the isthmus and the internal os. It is divided into two parts, the supravaginal and the infravaginal portions. The supravaginal portion is covered on its posterior surface by peritoneum, but on the anterior and lateral surfaces it is in contact with extraperitoneal connective tissue. The cervix is composed of connective tissue in which are many non-striated muscle fibres, many vessels and some amount of elastic tissue. The lining membrane is covered by columnar epithelium containing compound racemose glands. In the non-gravid condition the length of the cervical canal is about 2.5 cm. from the internal to the external os. The external os is nearly circular in nulliparous women, but after delivery the orifice may become a transverse slit. In some cases, even in nulliparae, the orifice is transverse.

Ligaments of the Uterus. Certain ligaments keep the uterus in position. These are the broad ligaments, the round ligaments, the utero-sacral ligaments, and Mackenrodt's ligaments, or the ligamenta transversalia coli.

The *broad ligament* on each side is a double layer of peritoneum directed from the lateral margin of the uterus to the lateral wall of the pelvis. It serves to divide the pelvic cavity into an anterior and a posterior compartment. The two layers of peritoneum, which form the broad ligament, enclose extraperitoneal connective tissue, the Fallopian tube, the round ligament and true ligament of the ovary, the par-oophoron and the ep-oophoron, and certain blood vessels, nerves and lymphatics.

The *round ligaments* extend on either side from the antero-lateral angle of the uterus just below and in front of the insertion of the Fallopian tubes. They are enclosed between the serous layers of the broad ligaments and pass laterally through the internal abdominal inguinal rings into the inguinal canals, and finally merge in the labia majora.

The *utero-sacral ligaments* are two condensations of visceral pelvic fascia extending from the posterior and upper portion of the cervix to the fascia covering the second and third sacral vertebrae.

The *ligamenta transversalia coli*, or *Mackenrodt's ligaments*, also spoken of as the *cardinal ligaments*, are thickened bands of fibromuscular tissue stretching across the pelvis. They run in the base of the broad ligaments, being attached medially to the side of the cervix uteri and vaginal vault, and laterally to the side wall of the pelvis.

Peritoneal Relations. The pelvic peritoneum is a continuation of the peritoneal investment of the anterior wall of the abdomen. As seen in a mesial sagittal section it will be found that the peritoneal investment, as it comes along the posterior aspect of the anterior abdominal wall, behind the symphysis pubis, arches over the fundus of the bladder and a portion of the posterior surface, and is then reflected over the upper two-thirds of the anterior surface of the body of the uterus, covers the fundus of the uterus, and passes along the whole of the posterior surface of the body of the uterus, and is thereafter continued downwards over the posterior surface of the supravaginal portion of the cervix and the upper third of the posterior vaginal wall. From there it is carried on to the anterior rectal wall, and in its lower part covers only the anterior wall of the rectum; whilst higher up it covers the lateral wall also, and at the level of the promontory it passes on to the peritoneum of the posterior abdominal parietes. As the peritoneum is reflected on either side of the uterus it is prolonged laterally in a fan-shaped manner, forming the broad ligament on either side. The pouch formed by the reflection of the peritoneum from the posterior surface of the bladder on to the anterior surface of the body of the uterus is known as the utero-vesical pouch; whilst the pouch of Douglas, which is much deeper, is formed by the reflection of the peritoneum which covers the posterior wall of the uterus and the supravaginal portion of the cervix to the anterior rectal wall. The utero-sacral ligaments, posteriorly, divide this pouch into three compartments, a mesial deeper fossa, which is properly spoken of as the pouch of Douglas, and two lateral shallow fossæ, the para-rectal fossæ.

The Fallopian Tubes. Lying in the medial four-fifths of the upper border of the broad ligament the Fallopian or uterine tubes

are situated one on either side of the uterus. They are attached to the uterine cornu and measure in length about 10-12 cms. They are convoluted and their free ends are near the ovaries.

The Fallopian tube may be divided into four portions—the interstitial, isthmal, ampullary and infundibular portions. The interstitial portion is that part of the tube which is included within the muscular wall of the uterus. The isthmus is the narrowest

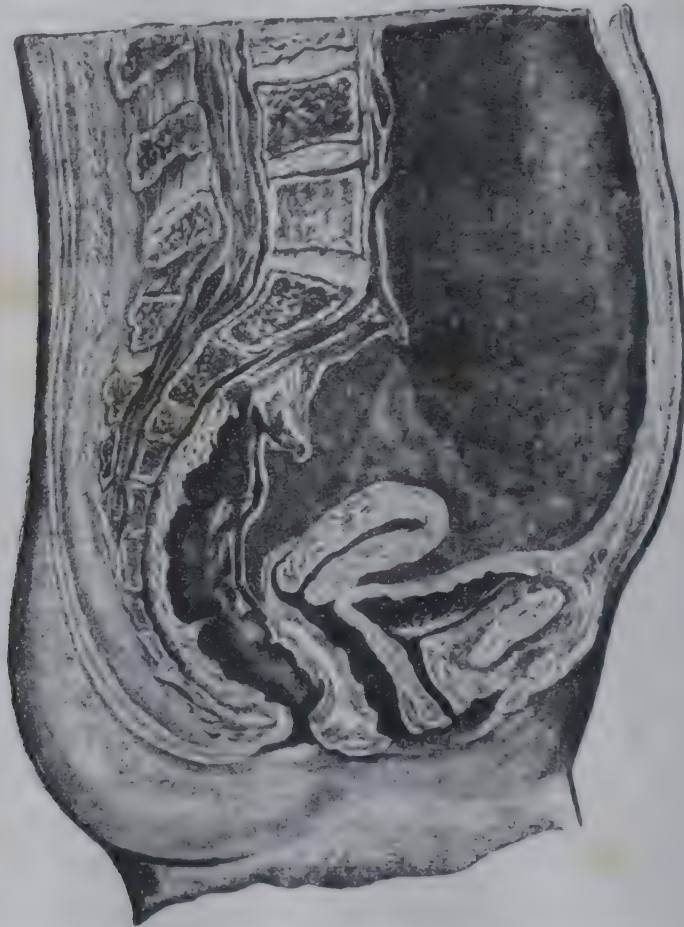


FIG. 8.—Sagittal section of female pelvis with the peritoneal relations.

portion immediately adjacent to the uterus. The ampulla is the widest part of the tube and ends in a fimbriated end, which is the outermost end of the tube and is known as the infundibulum. This opens directly into the peritoneal cavity by an ostium, which is surrounded by a number of radiating fimbriæ.

The wall of the tube consists of two layers of muscle—the inner circular and the outer longitudinal. Externally is the peritoneum of the broad ligament. The lumen of the tube is lined by mucous membrane which is thrown into folds called plicæ, consisting of a fibrous tissue core lined by a single layer of ciliated epithelium.

The Ovaries. These are two almond-shaped bodies, which are situated at the outer extremity of the Fallopian tube and attached to the posterior surface of the broad ligament by the mesovarium and to the lateral pelvic wall by the infundibulo-pelvic ligament.

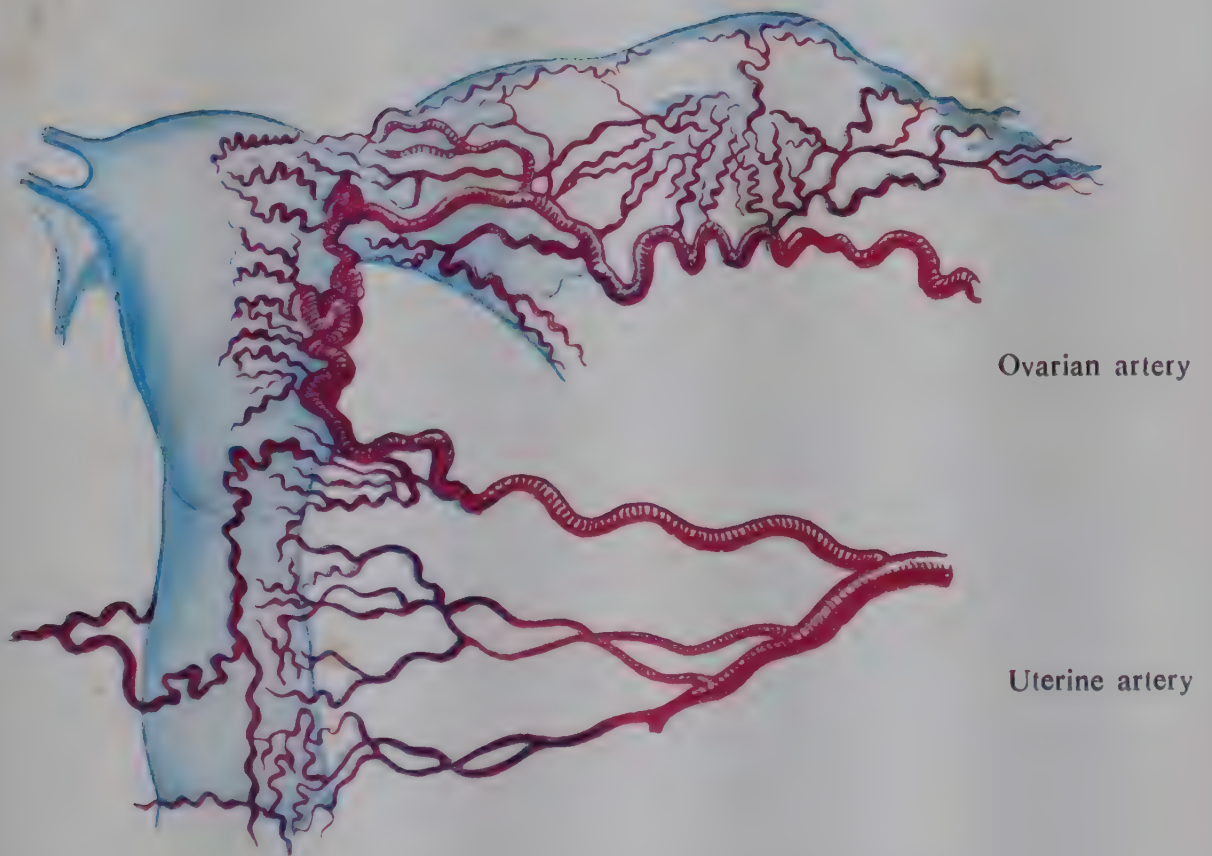


FIG. 9 — Blood supply of the internal genitalia.

The ovarian ligament extends from the upper end of the lateral wall of the uterus just below and behind the insertion of the Fallopian tube, to the inner or uterine pole of the ovary.

The ovary is divided into three regions—the hilum, the medulla and the cortex. The hilum is the small area composed of connective tissue and unstriated muscle fibres through which the ovarian vessels, lymphatics and nerves pass into the ovary from the broad ligament. The cortex of the ovary is the outer layer where the Graafian follicles are situated. Its surface is lined by a single layer of cells called the germinal epithelium, continuous at the hilum with the peritoneum of the broad ligament. The ovary has no peritoneal covering. The medullary portion is the central portion of the ovary, composed of connective tissue and a large number of blood vessels.

Blood Vessels, Lymphatics and Nerves

Blood Vessels. The pelvic organs in the female are supplied by the ovarian, uterine and vaginal arteries. The vulva is supplied by the internal pudic artery. The ovarian artery is a branch of the abdominal aorta. It runs along the upper part of the broad ligament to the uterine cornu, where it anastomoses with the terminal branch of the uterine artery. It supplies the ovary and the Fallopian tube.

The uterine artery arises from the anterior branch of the internal iliac artery. It runs downwards, forwards and medially in the base of the broad ligament, crosses above the ureter and passes to the side of the uterus. Just before the main branch turns abruptly upwards a small branch is given off, the cervico-vaginal artery, which supplies the lower portion of the cervix and the upper portion of the vagina. The main artery, which proceeds upwards in the broad ligament along the lateral border of the uterus, gives off many branches, and finally sends a branch to anastomose with the ovarian artery; while a second one passes in the meso-salpinx supplying the Fallopian tube, and a third goes to the fundus.

The veins which emerge from the uterine fundus, Fallopian tube and ovary form the pampiniform plexus. From this two ovarian veins emerge, which later fuse to form the single ovarian vein, which on the left side joins the renal vein and on the right side the inferior vena cava. The uterine veins accompany the uterine artery and end in the corresponding internal iliac vein.

The vaginal artery springs from the anterior division of the internal iliac artery below the uterine artery. It supplies the vagina, while some twigs anastomose with the uterine artery. The vaginal veins form a plexus round the vagina and empty into the internal iliac vein.

The internal pudic artery supplies the vulva and the perineum, and the accompanying veins pass into the inferior hæmorrhoidal and inferior vesical plexus.

The Lymphatics. There are a large number of chains of glands which receive the lymphatics from various portions of the female generative tract. These glands are grouped as the aortic, the common iliac, the external iliac, the internal iliac, the obturator, the inguinal and the sacral glands. The aortic glands drain the lymphatics from the ovary, Fallopian tube and the body of the uterus. They also drain the lymphatics coming from the iliac glands. The common iliac glands, which are situated along the common iliac artery on either side, receive the lymphatic vessels from the external and internal iliac glands and directly from the viscera. Lymphatics from this chain pass to the aortic glands. The external iliac glands are related to the external iliac vessels, and are situated in three chains—the outer, the middle and the inner. They receive the lymphatics from the femoral obturator and the inguinal glands, the clitoris, the bladder, the upper part of the vagina and the cervix uteri. From the external iliac glands, lymphatics pass on to the common iliac glands. The internal iliac glands are in relationship with the internal iliac artery and receive the lymph from the lower portion of the rectum, the bladder, the cervix and the upper part of the vagina. From these, lymphatics pass to the common iliac glands. The inguinal glands drain the lymphatics from the perineum, the anus, the vulva and the lower part of the vagina. A few lymphatic vessels from the fundus of the uterus, which accompany the round ligaments, also drain into this set of glands. From here the lymphatics pass on to the external iliac glands. The sacral glands lie in front of the sacrum on the inner side of the second and the third sacral foramina, and from them lymphatics pass on to the common iliac glands.

Innervation. The nerve supply of the uterus is derived principally from the sympathetic nervous system and partly from the cerebrospinal and parasympathetic systems. The parasympathetic or autonomic system is represented on either side by the pelvic nerve which consists of fibres from the second, third and fourth sacral nerves and ends in the ganglion of Frankenhauser. The sympathetic nerve arises from the hypogastric plexus which is situated just below the promontory of the sacrum and in front of the aorta and its division. Both the sympathetic and parasympathetic nerves supply the uterus, bladder and upper part of the vagina.

PHYSIOLOGY OF THE FEMALE GENERATIVE ORGANS

THE organs of generation do not mature till the second decade of life, and after a certain period, which varies with different individuals, some of the functions cease. The essential organ of reproduction in the female is the ovary, as here are produced the ova. The accessory organs include the oviducts or Fallopian tubes, the uterus in which the fertilised ovum is retained during the period of pregnancy and where it develops, and the vagina, which is the passage through which the spermatozoa are enabled to pass upwards. The mammary glands, which undergo a special development during pregnancy, may also be considered as accessory organs. They serve for the nourishment of the infant during the initial period of its extra-uterine life.

Ovulation and Menstruation

Menstruation may be defined as a periodic physiologic discharge of blood, mucus and other cellular debris from the uterine mucosa which occurs at more or less regular intervals except during pregnancy and lactation, from the time of puberty to the menopause. The average age at which menstruation begins is between the twelfth and fourteenth year but in a minority it may start as early as the tenth or as late as seventeenth year and still be within normal limits. The term menarche is used to indicate the onset of the first menstruation and the term menopause may be defined as the final cessation of menstrual function. This occurs on an average at about 45 years but there are wide variations.

The periodicity of the menstrual cycle is very variable. Generally it occurs at an interval of 28 days but there is great variation among women in general as well as in the cycles of any individual woman. The duration of the flow is also variable the usual being 3-6 days.

Ovulation

The primordial follicles develop into fully formed graafian follicles with the onset of puberty. This process of maturation is essentially controlled by hormones. The synthesis and release of the ovarian hormones oestrogen during the early proliferative phase and progesterone plus oestrogen during the later luteal phase is regulated by the pituitary gonadotrophic hormones—follicle stimulating hormone FSH

and luteinizing hormone LH. The role of luteotrophin or prolactin in humans is obscure. Under gonadotrophic stimulation a number of follicles develop in the ovary in each cycle, but the majority of these become atretic and degenerate, only one of them maturing into a graafian follicle. The maturing follicle shows an increased rate of growth during the last few days of the proliferative phase, associated with increased production of œstrogens which cause characteristic changes in the endometrium, the vaginal mucosa and the cervical mucus. The phase is also associated with an increased LH secretion with graafian follicle rupture, ovulation and development of the corpus luteum. The corpus luteum elaborates considerable quantities of progesterone and also some œstrogen and these hormones prepare the endometrium for implantation, render the cervical mucus hostile to sperm penetration, and alter the vaginal mucosa. Unless the corpus luteum is exposed to massive stimulation from the products of conception, its functional life is limited, and some 14 days after ovulation steroid secretion decreases so markedly that the endometrium is desquamated and shed in the form of menstrual bleeding.

The secretion of pituitary gonadotrophins is regulated by hypothalamic centres, and the function of these centres is controlled by the circulating œstrogen and progesterone via a feed-back mechanism. Present knowledge of this mechanism is limited and vague, but it seems likely that the increase in output of œstrogen by the maturing follicle diminishes the secretion of FSH, and at the same time stimulates the release of LH. After ovulation the progesterone from the corpus luteum acts as an anti-œstrogen, preventing the continued release of LH by circulating œstrogen; when the corpus luteum regresses there is a diminished secretion of œstrogen and progesterone, which again seems to stimulate the release of FSH and a new array of follicles start their development.

The cyclical excretion of sex hormones leads to a series of synchronized events in the genital tract. During the time of follicular ripening, the endometrium undergoes proliferative changes in response to œstrogens. After follicular rupture, and under the simultaneous influences of progesterone and œstrogens, secretory changes appear in the uterine endometrium. These could also be called the changes of the 'pre-gravid phase' as they are preparatory to possible nidation. The morphological changes in the endometrium are associated with numerous biochemical events. The most notable of these is an increase of alkaline phosphatase activity at the time of ovulation and the formation of glycogen in endometrial stroma and glands during the luteal phase of the cycle.

If the ovum is not fertilized, the function of the corpus luteum fails after an interval of 14 days and is associated with degeneration

of the uterine endometrium. This starts with pre-menstrual shrinking of endometrial tissue. Bleeding then occurs from the spiral arteries exposed by shedding of functional layers of the endometrium. After several days, the basal epithelium regenerates and proliferative changes in the endometrium appear anew as a result of œstrogen from the next ripening follicle.

The associated changes in the vaginal epithelium can be described in 5 phases :

1. Menstrual phase (day 1 to day 4) : The vaginal smear contains mainly basophil cells as well as numerous leucocytes.
2. Post-menstrual phase (day 5 to day 8) : The smear shows mainly basophil cells with fewer leucocytes.
3. Oestrus phase (day 9 to day 14) : Under the influence of increasing amounts of follicular hormone, more acidophil cells appear. Hardly any leucocytes are now visible.
4. Post-ovulatory phase (day 15 to day 18) : The number of acidophil cells is unchanged but they tend to appear in clumps. Basophil cells and leucocytes again become visible.
5. Pre-menstrual phase (day 19 to day 28) : The number of basophil cells increases. There is clumping of cells and evidence of desquamation.

There is also a relation between cervical secretion and the phase of the menstrual cycle. Just after menstrual bleeding, the cervical canal appears to be closed. Cervical secretion is not very copious. Just before ovulation, copious amounts of thin cervical secretion are seen. Its 'Spinnbarkeit' or 'threadability' is particularly noticeable at this time. A few days after ovulation, the amount of cervical mucus again decreases as does its 'Spinnbarkeit'. Alterations in the mucus may also be seen in a dried smear. Between the 7th and 20th days of the menstrual cycle, a 'fern pattern' is seen as a result of crystal formation. If ovulation has occurred, the 'fern pattern' is not seen from the 20th to 26th days of the cycle. The fact that these physico-chemical changes do not occur without ovulation is of clinical diagnostic importance.

It is generally accepted that the specific biochemical characteristics of alkaline cervical mucus at the time of ovulation facilitate sperm migration into the upper genital tract. By contrast, sperm penetrability is reduced or absent during the luteal phase of the menstrual cycle. Waking temperature records are of great diagnostic importance.

About one to three days after ovulation, the temperature rises by about 0.5° as a result of the central thermogenic effect of proges-

terone. This rise in temperature is maintained until the onset of menstruation.

Breast development commences before the menarche. This occurs in several stages and is the result of increasing amounts of œstrogen. Full female breast maturation appears only when the breast alveoli develop in response to progesterone. Oestrogens and progesterone thus act synergistically.

MATURATION AND FERTILISATION OF THE OVUM

THE human ovum at ovulation measures 0.2 mm. in diameter. Before it is extruded from the follicle it undergoes a process of maturation, first casting off one polar body and then a second polar body. By this process the number of chromosomes in the cell is reduced by one-half. A similar process has occurred in the spermatozoa before they lie free in the seminal fluid. After maturation the ova and spermatozoa may be called the female and male gametes respectively, and the fusion of the nuclear masses is called the union of the female and male pronuclei. The structure formed after fusion is the zygote ; this contains the full number of chromosomes.

The union of the gametes takes place most probably at the outer end of the Fallopian tube. After the ejaculation of the seminal fluid into the posterior fornix the spermatozoa make their way through the cervical mucous plug and thence up the uterine cavity and along the tube. They travel one inch per hour, and if the ovum is present in the outer end of the tube conception will occur here ten to twelve hours after intercourse.

There has been much discussion on the question of the survival period of the free ovum and spermatozoa. The ovum is probably incapable of being fertilised fortyeight hours after ovulation. Free spermatozoa have been found in the tubes days after intercourse, but it is now believed that they are no longer capable of fertilising the ovum, and spermatozoa probably do not retain this capacity for more than forty-eight hours at the longest. This problem is of more than academic interest as control of conception depends on a fairly accurate estimate.

Sex Determination. It was originally thought that the ovum and spermatozoon before maturation contained 48 chromosomes but recent investigations have shown this to be wrong. The human cell is now known to contain 46 chromosomes and this figure has been confirmed by many workers in this field. In the ovum, therefore, there are 44 somatic chromosomes plus two sex 'X' chromosomes ; in the spermatozoon there are 44 chromosomes plus an 'X' and a 'Y' sex chromosomes. After maturation these are reduced to $22 + X$ in the ovum and $22 + X$ or $22 + Y$ in the spermatozoon. After union of the gametes the zygote will contain, therefore, $44 + 2X$ chromosomes or $44 + X + Y$ chromosomes. An X and Y sex chromosome will result in a male child and two X chromosomes in a female child.

Early development of the embryo. With the arrival of the fertilised ovum in the uterus, extensive changes begin in this and in the neighbouring organs of generation. The walls of the uterus hypertrophy. There is a great growth of the blood vessels, which have to supply not only the growing wall of the uterus but also the nutritional needs of the developing fœtus through a special organ—the placenta.

After fertilisation the ovum undergoes a series of cell divisions, which follow one another in close succession, until a small sphere of cells is formed. This is called the *morula*, and the stage is called the *morula stage* or the *mulberry stage*. The process of differentiation now commences in the cells of the morula. Its outermost layer constitutes the trophoblast and cells in its interior differentiate into a closely packed inner cell mass and a loosely arranged primary mesoderm. The cells of the trophoblast differentiate further into an inner cellular layer, which is termed the cytotrophoblast or Langhans' layer, and an outer syncytial layer termed the plasmoditrophoblast. The plasmoditrophoblast throws out a large number of irregular villous processes which exert a histolytic action on the uterine mucosa, and not only effect embedding of the ovum in the maternal tissues but also, a little later, provide the channels by means of which the developing embryo is enabled to draw nourishment from the maternal blood. While these changes are occurring in the trophoblast, the inner mass undergoes differentiation which results in the formation of two hollow vesicles. Of the two vesicles so formed, one remains in close contact with the trophoblast and constitutes the amnio-embryonic vesicle, the other is placed more centrally and is usually referred to as the yolk-sac.

The Differentiation of the Embryonic Area. The embryonic area shows no distinguishing features in its earlier stages. At first merely circular, its outline rapidly alters and becomes oval, indicating the long axis of the body. In the middle of the embryonic area a slight depression appears, which is known as the primitive streak, and on either side of it there is a slight elevation, the primitive fold. The presence of the primitive streak indicates that rapid growth is occurring throughout its site. Shortly afterwards a second thickening occurs—the medullary plate—from which by far the greater part of the central nervous system is developed. The raised ridges constitute the neural folds, and the groove which separates them is the neural groove. From this primitive node a rod-like process of cells grows headwards in the median plane and separates the fold of the neural groove from the subjacent roof of the entodermal vesicle. This is termed the head process and it is the forerunner of the skeletal axis of the body. The head process becomes very intimately connected with the underlying entoderm, and both the cells forming the floor of the canal of the head process and the entoderm cells in

contact with them break down, so that the canal communicates freely with the vesicle and at its caudal end a communication is established between the entodermal vesicle or arc-enteron and the amniotic cavity. This connection is termed the *neurenteric canal*. At a later stage the three layers in the human embryo develop, contributing to the forming of systems and organs which show distinct functional differences. These three layers are the ectoderm, the entoderm and the mesoderm.

Further details regarding the development of the embryo can be found in any book on Embryology.

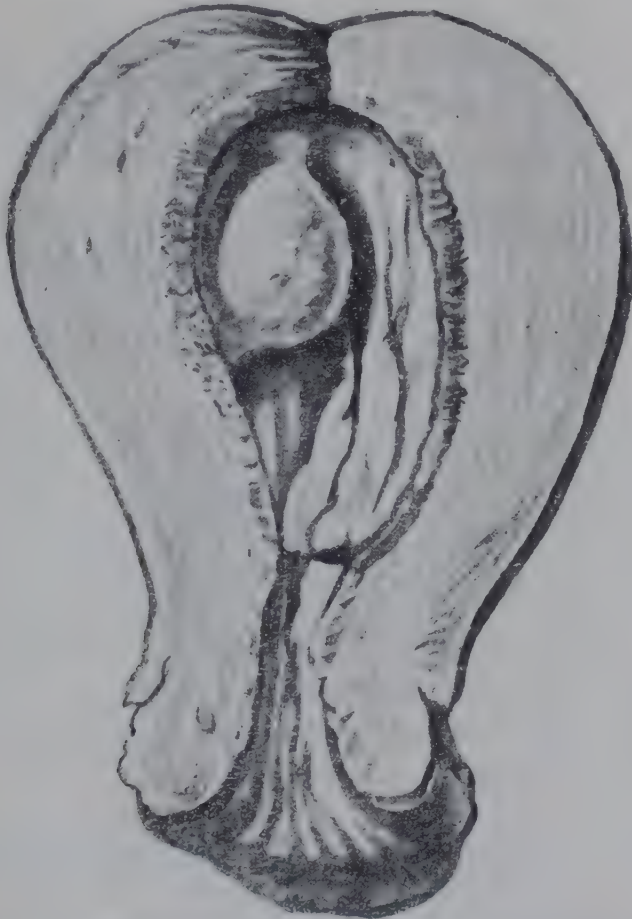


FIG. 10.—Early embedding of the ovum (in section).

The Fœtal Membranes and the Placenta. *The amnion* is a double layered translucent membrane. Its outer layer is mesodermal connective tissue and its inner layer is ectoderm. Although it consists generally of a few layers of stratified squamous cells, patches of low cuboidal cells are also seen. The chorion and amnion arise from the placenta at its margin to envelop the fœtus. They strip easily from the fœtal surface of the placenta and can be separated from one another by careful dissection.

The liquor amni. Very early in human development a clear fluid collects in the amniotic cavity surrounding the embryo. The amount increases rapidly with the growth of the products of conception averaging about 50 ml. at 12 weeks of pregnancy. At 20 weeks its

volume is about 400 ml. and at 38 weeks it reaches a peak of nearly a litre. During the last few weeks of pregnancy its volume decreases and at 43 weeks the range varies from 100 to 600 ml.

Even though the amniotic fluid is ultimately derived from the maternal organism the exact site of origin is still conjectural. The fluid may arise as a transudate of the maternal serum across the placenta or foetal membranes. It may arise as a transudate across the umbilical cord itself or directly from the foetal urine. In addition the foetal tracheo-bronchial tree may contribute to its formation as may also the foetal skin surface.

In the latter part of pregnancy the amniotic fluid is slightly alkaline (pH about 7.2). The fluid is hypotonic. The concentration of electrolytes is essentially the same as that found in maternal blood. As pregnancy advances there is a fall in the concentration of both sodium and chloride. The concentration of potassium remains unchanged. The decrease in electrolyte concentration is thought to be the result of the addition of very hypotonic foetal urine to the existing amniotic fluid. The concentration of urea, uric acid and creatinine gradually increases both in foetal urine and in the amniotic fluid as pregnancy reaches term. Extensive chemical studies have been made on the amniotic fluid. The average values are protein 0.5 g. non protein nitrogen 24 mg., uric acid 4.5 mg., sugar 19 mg., calcium 5.5 mg. and phosphorous 3.5 mg. per 100 ml. of amniotic fluid.

Early in pregnancy the amniotic fluid is clear but during the latter half of pregnancy there are increasing amounts of suspended particles consisting of desquamated foetal squamous epithelial cells vernix caseosa and lanugo hairs.

Recent studies have demonstrated the presence of various hormones in the liquor amni-cortisone, 17-hydroxycorticosteroids, pregnanediol, progesterone, 17-ketosteroids, pregnanetriol and oestriol have all been found in the liquor. In addition prostaglandins have also been found.

The amniotic fluid serves several important functions. It provides a medium in which the foetus can readily move, protects it against possible injury and helps to maintain it at an even temperature.

An excessive amount of liquor amni has been found in the following foetal conditions (1) anencephaly and other foetal abnormalities as also in multiple pregnancy, (2) severe hydrops foetalis, (3) congenital obstruction of the oesophagus or upper gastrointestinal tract, (4) central nervous system defects (meningocele). In maternal diabetes also an excess of amniotic fluid is found.

Diminution in the volume of amniotic fluid has been found in

association with foetal bilateral renal agenesis, congenital occlusion of the lower urinary tract and placental insufficiency.

Studies of liquor amni is gaining more and more importance in clinical obstetrics. It is now possible to determine the foetal sex by a study of the liquor. Its importance lies within the field of genetics and transmission of sex-linked disorders like hæmophilia, progressive muscular atrophy, can now be prevented. The detection of chromosomal abnormalities *in utero* has also been made possible through tissue culture of amniotic fluid cells. Attention to the amniotic fluid should prove to be of value in the following clinical situations: (1) sex-linked disease, (2) chromosomal abnormalities, (3) metabolic disorders, (4) Rh isoimmunisation, (5) acute foetal distress, (6) placental insufficiency and (7) estimation of foetal maturity.

The Chorion consists of two layers, an outer of trophoblast, and an inner of primary mesenchyme. The trophoblast, as already stated, undergoes rapid proliferation and forms on the surface of the chorion numerous processes which are known as the primary chorionic villi. These increase in size and ramify, and the chorionic mesenchyme carrying branches of the umbilical vessels grows into them, and in this way they are converted into secondary chorionic villi. With the growth of the embryo and the expansion of the amniotic cavity, the decidua capsularis is thinned and compressed, the circulation through it is gradually cut off, and the villi of the corresponding part of the chorion atrophy and disappear. This portion of the chorion becomes smooth, and as it takes no share in the formation of the placenta, is sometimes termed the non-placental part of the chorion. On the other hand, the villi on that part of the chorion which is in contact with the decidua basalis, increase greatly in size and complexity, and hence this part is named the chorion frondosum.

The layer of mucous membrane which covers the ovum is called the *decidua capsularis*, that portion on which the ovum rests is termed the *decidua basalis* and all the rest of the lining of the uterus is called the *decidua vera*.

The Umbilical Cord. This is formed by an outer covering of amniotic ectoderm, containing in its interior the vitello-intestinal duct and the yolk-sac or umbilical vesicle. The umbilical cord incorporates within itself the body stalk and its contained umbilical vessels (two arteries and one vein) and the allantois. It is spirally twisted and it increases in length, so that at the end of pregnancy it is about 50 cm. long.

The umbilical cord connects the foetus with the placenta and conveys foetal blood to and from the latter. On cross section the

cord shows the covering of amniotic epithelium, generally two arteries and one vein, the remains of the allantois with the whartonian jelly which binds all together.

Development of the Placenta. We have already discussed the changes occurring in the surface cells of the ovum and seen that after its embedding there is developed around the whole periphery a mass of syncytiotrophoblast, the trophoblastic shell. At first these cells simply digest the endometrial and stromal cells. But the ovum is in urgent need of oxygen and soon maternal vessels are opened up, and thereafter the larger spiral arterioles, so that the ovum becomes bathed in a lake of maternal blood. This ensures the supply of oxygen and food. Attachments to the uterus must also be made. These needs are fulfilled by the growth of the chorionic villi. Quite soon small buds of syncytiotrophoblast can be seen on the trophoblastic shell. These buds grow at a truly remarkable pace, so that shortly the whole ovum is surrounded by a mass of delicate villous structures. At first these are composed of the syncytiotrophoblast, then there appears a core of discrete paler cells called the cytotrophoblast or Langhan's layer. About the same time the mesoderm is growing into the villi and *in situ* the afferent and efferent vessels are being developed. The villus is now mature. Most of the chorionic villi which branch and rebranch in a complicated manner float freely in the maternal blood lake and expose a very large area to the blood circulating there ; these are called nutritive villi. The vessels in the villi join with each other until they are collected in the body stalk to form the umbilical vessels. Other villi are attached directly to the decidua, particularly in the region of the decidua basalis. Their main function is to ensure anatomical fixation of the growing ovum, and consequently they are called anchoring villi. At the tip of such a villus the Langhan's cells are seen to grow directly into the decidua, and frequently small clumps of deeply staining masses of syncytiotrophoblast can be seen at a considerable distance from them and even in the myometrium. These are the wandering trophoblastic cells. The trophoblast from these anchoring villi spreads over the surface of the decidua basalis, so that the whole of the maternal blood space is lined with trophoblastic cells.

At first these chorionic villi are developed around the whole periphery of the ovum, but as it grows those adjacent to the decidua capsularis atrophy, and by the third month have largely disappeared. This forms the chorion laeve. Those developed in relation to the decidua basalis grow rapidly to take part in the formation of the mature placenta. This area is known as the chorion frondosum.

The structure of a villus. The young villus is a delicate structure covered by a layer of syncytiotrophoblast which is sometimes

condensed into deeply staining knots at its free tip. Beneath this is the cytotrophoblast composed of discrete cubical cells. At first this is two layers thick, then a single layer and in the mature villus it has entirely disappeared. The mesodermal core of the young villus is comparatively thick but is very thin in the mature organ. The capillaries of the villus are thin-walled structures with no special features.

It will be seen, then, that metabolites must pass through these several layers on their way to and from the foetal blood stream. In the mature or ageing villus certain stigmata of age are apparent. The syncytium may be represented by an extremely thin film, and here and there may be replaced by little clots of fibrin—the fibrin nodes. The Langhan's layer has disappeared and the mesodermal core is greatly attenuated.

It will be quite clear that there is no mixing of maternal and foetal blood the two circulations being separated by the chorionic epithelium and mesodermal structures. The human placenta is said to be hæmo-chorial for the foetal chorion is in direct contact with maternal blood. That occasional breaks in chorionic integrity may occur has long been suspected, and fragments of chorionic villi have been found in the maternal lungs.

The Placenta at term. This connects the foetus to the uterine wall and is the organ by means of which the nutritive, respiratory and excretory functions of the foetus are carried on.

At term the human placenta is a discoid organ measuring 15 to 20 cm. in diameter, 2 to 3 cm. in thickness and weighing about 500 gms. Usually it is implanted on the posterior or anterior surface of the uterine cavity, well towards the fundus. On examination of the maternal surface of the expelled placenta one can see that it is divided by depressed areas of varying depths into irregularly shaped lobes known as cotyledons. The depressed areas are the bases of the placental septa which are made up of mostly fibrous tissue. The septa extend only to about three quarters of the way to the chorionic plate. They are maternal in origin. Very few functional vessels are seen in it at term. The cotyledons are filled with loose villi attached only to the major villous stalks. Above the area where the septa cease, the villi are relatively sparse. Spanner calls it the 'subchorial lake'. In the placenta there are two circulations—foetal and maternal.

The Foetal Circulation. The foetal blood flows to and from the placenta at the attachment of the umbilical cord through the arteries and one vein. The vein carries oxygenated blood to the infant while the arteries deliver venous blood to the placenta. The vessels course

through the chorionic plate and into the larger stem villi. They festoon into small free floating finely branched villi. The vessels follow the branching villi becoming smaller and smaller ending in smaller terminal villi containing only a capillary network.

The Maternal Circulation. Blood actually leaves the maternal circulation and flows into a 'Lake' lined by foetal syncytium and not maternal endothelium. The blood then drains back into maternal veins. There is normally no gross intermingling of the maternal and foetal blood. The supply and drainage of the intervillous space is still controversial. According to Spanner the arterial blood entered at the base of the cotyledons flowed upward to the subchorial lake and laterally to the marginal sinus where all of the venous drainage of the placenta took place.

More recent studies of Ramsey indicate that there is venous drainage and arterial inflow scattered indiscriminately over the entire base of the placenta. The spiral arteries lie more or less perpendicular to the uterine wall while the veins generally run parallel to it, thus facilitating the closure of the veins during uterine contraction and preventing the squeezing of vital maternal blood from the intervillous space. The spiral arteries pour their blood into the intervillous space. The arterial blood then filters in all directions gradually draining downward to pass out through the basally distributed veins.

The foetal and maternal circulation were formerly considered entirely separate. There is now convincing evidence of the escape of foetal cells into the maternal circulation. The increasing frequency of A, B, O iso-immunisation indicates that this escape of foetal cells into the maternal system is much more frequent than was formerly thought.

The average increase in weight of the foetal placenta is proportional to the term from twelve to thirty weeks of pregnancy. Thereafter to term the weight increase is small and there is no further rise in the postmature period. At term about 150 ml. of blood may be transferred from the placenta to the infant if ten minutes are allowed to elapse before the cord is tied.

The Functions of the Placenta. The placenta may be considered as a wall which separates the maternal and foetal circulations but through which certain constituents pass unaltered or altered from one side to the other. The foetal endothelial lining of the villus capillaries forms one side while the other side consists of a single or double layer of trophoblastic epithelium covering the villus. Between these two layers, a certain amount of connective tissue intervenes.

The transfer of immunity to certain diseases furnishes an excellent example of the species differences in the placental barrier between the maternal and foetal bloods. In the human subject, immune bodies are transferred from mother to foetus through the chorionic villi while in certain animals like the cow the offspring is born without such immunity but obtains its protection by taking the globulin rich early breast secretion. It is therefore not necessary for the new-born human to take the colostrum or early secretion of its mother's breast to be protected against certain infections while in the case of the calf, it may succumb to infection if it does not have it.

Transfer across the placental barrier is accomplished by at least 4 different processes : (1) Diffusion (2) selection by means of enzyme carriers (3) engulfment of particles by cells (4) leakage through defects.

Substances required for the maintenance of foetal life and elimination of its waste products are handled largely by diffusion across the placental barrier. Included in this group are Oxygen, CO_2 , water, electrolytes and urea.

Oxygen Absorption from the Placental Sources. At first, the blood which flows through the placental site is only slightly altered by its contact with the villi but later, when the growth of the foetus is accelerated, marked changes take place. Early in pregnancy, the blood which enters the pregnant uterus with an oxygen saturation of nearly 95% leaves with a saturation of 80%. Most of this blood is shunted across the arterio-venous anastomoses into the venous system without passing through the capillaries of the uterus. For this reason, the blood which passes through the placenta does not give up its oxygen to support the metabolism of the uterus and in the early stages of gestation, only a small part of its oxygen is taken up by the products of conception. As pregnancy advances and the requirements of the growing foetus are increased, more and more oxygen is absorbed. With the approach of term, the blood which flows out of the intervillous space is very much reduced in oxygen concentration. It is to be noted that death of the foetus invariably occurs when the pregnancy is prolonged more than a certain period by the administration of gonadotrophic hormone in animals. Excessively large human foetuses also die *in utero* before the onset of labour more frequently than do those of normal size. It may well be that the oxygen supply or rather the relative lack of it is related to the intra-uterine death of some of these large foetuses. Lack of oxygen may be a factor in the high foetal mortality which accompanies pregnancy in diabetic women. In cases of anæmia, or in certain diseases like pneumonia, and after profuse hæmorrhage as in a case of placenta prævia, the supply of oxygen is seriously reduced and intra-uterine death of foetus may occur.

Enzymatic processes supply many foetal nutritional needs. Glucose, amino acids, calcium, phosphorous, iron and probably some of the vitamins cross the placental barrier by this means.

Carbohydrate Metabolism. In the early months of pregnancy, glycogen is stored in the placenta until the liver and pancreas are sufficiently developed to take over the function of storing and utilizing this carbohydrate. As it contains glycolytic enzymes, the placenta also is able to convert its store of glycogen into absorbable glucose. Most of the foetal carbohydrate is absorbed from the mother's blood in the form of glucose which passes readily through the placenta.

Vitamins. The water soluble vitamins B₁ and C pass through the placenta readily and the latter is retained in excess in the foetal blood. Riboflavin is transmitted by the absorption and degradation of its dinucleotide precursor. The fat soluble vitamins A, E and K probably are also transmitted through the placenta but definite evidence concerning the permeability of the placenta to vitamin D is lacking.

Hormones. Tissue culture studies show that the cytotrophoblast produces chorionic gonadotrophin. The syncytiotrophoblast is the source of sex steroid hormones (oestrogens and progesterone) corticoids and even adrenocorticotrophic hormones (ACTH). One of the major placental hormones recently identified is the Human Placental Lactogen (HPL) which has prolactic, leuteotrophic and somatotrophic properties. It can be identified in the maternal serum. It increases in a linear fashion as pregnancy advances.

The rise in plasma and urinary corticosteroids which has been noted during pregnancy has been interpreted as indicating an extra adrenal source of these hormones, possibly the placenta. The 17-hydroxycorticosteroid concentration in the foetal blood at term is one-third to one-half that of the maternal blood and it diminishes rapidly during the neonatal period. The rapid fall indicates a lack of production by the foetus.

Oestrogen, progesterone and chorionic gonadotrophin, the three hormones that are so essential in pregnancy, are produced chiefly by the placenta and probably are supplied to the foetus by this organ. It is probable also that the placenta is permeable to thyroxin, insulin and prolactin but is impermeable to thyrotrophin, parathormone and posterior pituitary extract.

Drugs. The placenta has also been found to be permeable to alcohol, chloroform, ether, morphine, insulin, the barbiturates, ephed-

drine, penicillin, streptomycin, aureomycin, thiouracil, arsphenamine, sulphanilamide and various salts of sodium, potassium, copper and bismuth.

The placenta is however impermeable to the toxins of tetanus and diphtheria but permits the passage of antitoxins, agglutinins, bacteriolysins and complement fixing antibodies.

To summarize the functions of the placenta, it may be said that it can no longer be regarded solely as a passive semipermeable membrane in which the rate of transfer of materials across its villi is related to the size of their molecules and the morphologic changes which occur in the villi at different periods of gestation.

The Physiology of the Fœtus

During the early period of its development the fertilised ovum is dependent for its nourishment on the remains of the cells of the discus proligerus adhering to it or on the fluid of the Fallopian tube into which it is immersed. From the second week onwards blood vessels traverse the chorionic villi and come into close relation with the maternal blood, and from this period the whole growth of the fœtus is to be maintained by a special development of these connections in the placenta.

In the fully formed fœtus, blood passes from the fœtus to the placenta by the umbilical arteries and is returned by the umbilical vein. There is no communication between fœtal and maternal circulations. The placenta represents the fœtal organ of respiration, nutrition and excretion. Thus the umbilical arteries carry to the placenta dark venous blood which, in this organ, loses its carbonic acid and takes up oxygen, so that the blood of the umbilical vein is arterial in colour. The oxygen requirements of the fœtus are, however, very small. It is protected from all loss of heat, movements are sluggish, and the only oxidative processes are those required for the building up of the developing tissues. On the other hand, the fœtus has need of a rich supply of foodstuffs which it must obtain through the placental circulation.

The Fœtal Circulation. The fœtal circulation differs from adult circulation in some material respects. The blood-vessels traverse the umbilical cord and enter the umbilicus of the fœtus. Here the umbilical vein, which carries oxygenated blood from the placenta, passes directly into the liver, but before doing so it gives off a branch—the ductus venosus—which carries the greater part

of the blood directly into the inferior vena cava and thence to the right auricle. Here the blood stream impinges on the Eustachian valve and is directed through the foramen ovale into the left auricle, whence it passes into the left ventricle, to be driven into the aorta.

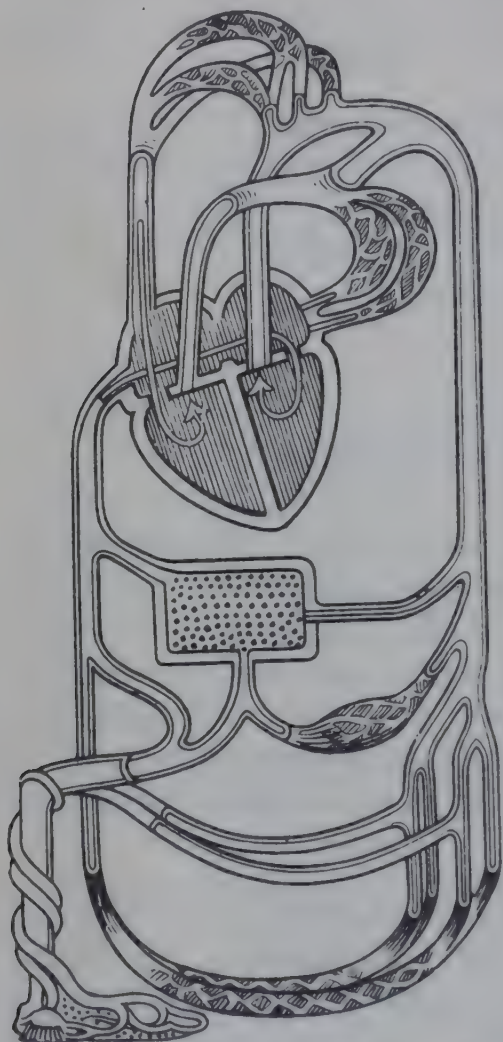


FIG. 11.—Schematic representation of the foetal circulation.

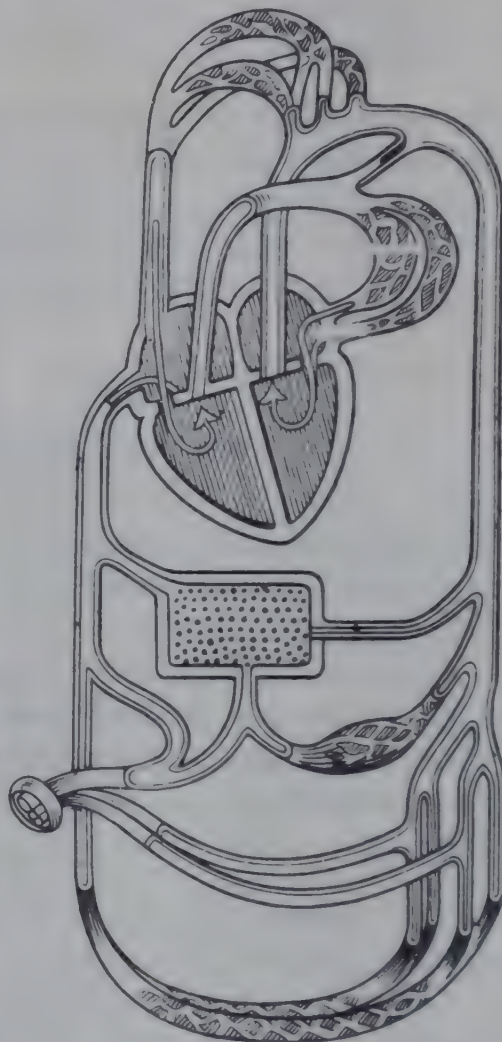


FIG. 12.—Schematic representation of the changes in circulation after birth of the child.

As this arterial blood passes into the inferior vena cava through the ductus venosus, it is of course mixed with the venous blood returning from the lower limbs and the lower part of the trunk. The aorta gives off the three main branches—the Innominate, left Common Carotid and left Subclavian—for the supply of the head and neck and superior extremities, and then descends as the Thoracic Aorta, passing eventually into the abdominal cavity as the Abdominal Aorta. The venous blood from the head and neck and superior extremities is returned to the right auricle by the superior vena cava, thence to the right ventricle, by which it is driven into the pulmonary artery. Only a small part of the blood passes through the lungs, the greater part traversing through a channel, the ductus arteriosus, which communicates with the aortic arch. The aorta divides into

the common iliacs which further divide into the internal and external iliacs; and from the internal iliacs the hypogastric arteries leave, ascending alongside of the bladder to the umbilicus and thence winding spirally around the umbilical vein as the umbilical arteries in the cord, they reach the placenta. Here they split up into arterioles and capillaries in the villi. The foetal blood contained in the placenta is thus constantly undergoing changes that in the adult occur in the lungs, the liver, and other blood-forming organs.

Changes after Birth

After the birth of the child, when the first inspiration is taken, all the mechanical conditions of the circulation are modified. The resistance to the blood flow through the lungs is diminished, and the blood passes from the pulmonary arteries through the lungs into the left auricle. The pressure in the left auricle is raised, while in the right auricle it falls, so that the foramen ovale is closed and kept so. The increased rush of blood from the right ventricle through the pulmonary artery, consequent upon the suction action of the circulatory system in the lungs, makes it impossible for any blood to go through the ductus arteriosus, which therefore collapses, becomes obliterated and shrinks up. Consequent on the ligature applied on the umbilical cord, the supply of the blood from the vein is cut off, the walls of the umbilical vein agglutinate, and the vein is obliterated, remaining as a cord-like ligament passing to the liver—the ligamentum teres. The ductus venosus also collapses and shrinks and becomes a vestigial structure. The hypogastric arteries contract and thrombose and form the obliterated hypogastrics of the adult. Hence the changes that take place in the circulatory system of the infant after birth are :—

- (1) Obliteration of the umbilical vein.
- (2) Obliteration of the ductus venosus.
- (3) Obliteration of the ductus arteriosus.
- (4) Closure of the foramen ovale.
- (5) Obliteration of the hypogastric arteries.

SECTION II

PHYSIOLOGY OF PREGNANCY

CHAPTER V

MATERNAL CHANGES DUE TO PREGNANCY

DURING pregnancy many demands are made on the maternal organism consequent upon the rapid growth of the fertilised ovum. The fertilised ovum requires increasing space for its proper development and an adequate blood supply for its nourishment. In consequence, there is a demand on various organs associated with the general metabolism for increased activity. To meet these requirements of the growing fœtus, the maternal system has to undergo certain changes and these will be referred to here.

The Uterus. The most marked changes are naturally noted in the uterus. In a nulliparous woman the uterus is a pear-shaped organ about 6.5 cm. long and 30 grams in weight and is situated within the pelvis. At term the uterus is found to have filled up the greater part of the abdominal cavity and to have undergone considerable hypertrophy. The uterus is then about 32 cm. long, 24 cm. wide and 22 cm. deep and weighs in the neighbourhood of 1000 gms. This is due chiefly to the hypertrophy of the existing muscle fibres and to the formation of new ones. The muscle fibres of the cervix also undergo hypertrophy, but not to the same extent as those of the uterine body. The uterine connective tissue is increased and becomes softer. In the first few weeks of pregnancy the body of the uterus assumes a globular form and later becomes almost spherical. Then it rapidly increases in length more than

in breadth, and finally assumes an oval form at the end of pregnancy. The uterus grows out of the pelvis by about the fourteenth week.

To keep pace with the growth of the uterus as well as the growing ovum, the blood supply of the uterus must be very liberal. The arteries hypertrophy, the veins are also increased in size, the lymphatics of the uterus enlarge and multiply during pregnancy, so that the full term uterus is richly supplied with blood and lymph.

The growth of the uterus is usually proportionate to the period of pregnancy, but under certain conditions it may be either much larger than the period of pregnancy would warrant, or even smaller. A few weeks before term there is a falling forward of the fundus, which gives rise to a feeling of relief to the mother.

The Fallopian tube on either side is generally stretched out in pregnancy and is much more vascular. The uterine end of the tube is usually closed, but the fimbriated extremity remains open.

The round ligaments are thickened and hypertrophied. The **ovaries** are enlarged, especially the one containing the corpus luteum.

The vagina is increased in vascularity, which is one of the most marked changes during pregnancy, and consequent upon this there is a more copious secretion and the characteristic violet discoloration of pregnancy. The vaginal secretion, derived partly from the cervix and partly from the transudation from the vaginal walls, is acid in character and during normal pregnancy, its pH varies between 3.8 and 4.4. The increased vascularity at the time of pregnancy is not confined to the genitalia, but extends to other organs in the vicinity. In consequence, there is a slight relaxation of the various pelvic joints which gives rise to an increase in their mobility.

The abdominal wall distends as the pregnancy advances and grows thinner, especially around the umbilicus. The skin over the abdomen shows depressed lines, pinkish or slightly bluish in appearance. These lines are called *striae gravidarum*. They are curved, irregular, arranged more or less concentrically, sometimes radially around the umbilicus, gradually becoming broader and deeper near Poupart's ligament. They may also be found over the thighs on the anterior aspect, sometimes on the posterior aspect as far as the knees, as well as under the breasts. These lines are caused by the rupture of the subcuticular elastic fibres, and after delivery they heal up, leaving pearly white or silvery bright lines, now known as *linea albicantes*.

The Breasts. Marked changes take place in the breasts. Such changes are more obvious in primigravidæ than in multipara. The

changes occur particularly at two different periods of pregnancy—about the second month and at the fifth month. During the second month the breasts increase in size and sensitiveness and a bluish discoloration appears in the form of streaks, especially at the periphery. The nipple becomes more erectile and, with the areola, more deeply pigmented. Prominent tubercles, Montgomery's follicles, are seen in the primary areola. Later, about the fifth month, a less deeply pigmented area forms around the primary areola, which is known as the secondary areola, and on this also some tubercles, secondary Montgomery's follicles, may appear. After the first few months a little clear, sticky fluid may be expressed from the nipples, which later becomes yellowish in colour. This is known as the colostrum.

Circulatory System. One of the principal alterations that take place in pregnancy is an increase in the blood volume. On an average, the total blood volume increases by about 30%, the increase in plasma being about 50% and the increase in the total cell volume being about 20%. Hyten and Leitch after reviewing the work of many authors using modern techniques sum up the present position of blood volume changes as follows: 'Healthy women in a normal first pregnancy increase their plasma volume from a non-pregnant level of about 2600 ml. by an average of at least 1250 ml.; in subsequent pregnancies the increase is greater and may average nearly 1500 ml. The maximum is reached at about 34 weeks with considerable individual variation: after the maximum there is a decline towards term averaging about 200 ml.' The increase in the plasma is chiefly due to hydræmia. These alterations in the volume of total blood, the plasma and the cell volume in pregnancy are of great clinical significance.

The cardiac output rises early in pregnancy from a mean of about 4.5 litres per minute before pregnancy to about 5.5 litres by about the 12th or 16th week. By about mid-pregnancy it increases to about 6.0 litres per minute and remains at that level until about the last eight weeks after which there is a steady decline to between 5 and 5.5 litres per minute at term. The increase in cardiac output is brought about both by an increased heart rate and increased stroke volume. There is an overall increase by about 15 in the pulse rate. Whether this increased output necessarily leads to a hypertrophy of the heart is a matter of some doubt. It is possible that the reserve power of the heart is able to cope with the increased needs during pregnancy as the strain on the heart is not sudden but gradual.

The blood-pressure normally varies between 110 mm. and 120 mm. Hg. systolic, and 75 to 85 mm. diastolic. Variations in blood-pressure are of extreme significance during pregnancy, and any rise up to or above 140 mm. systolic or 90 mm. diastolic, should always caution

the obstetrician to investigate the possibilities of toxæmia. A low blood-pressure is also of serious significance, particularly if the patient goes into labour.

Another change that may be noted in the circulatory system during pregnancy is an increased tendency to varicosity of veins. Venous pressure shows marked variations in pregnancy. The pressure in the veins of the arm is not altered but the pressure in the femoral and other leg veins is high. The high pressure in the femoral veins drops immediately after delivery. Varicose veins of the lower half of the body tend to develop in pregnant women. The usual sites are the legs, vulva, rectum, anus and vagina in the order named. There are several causes among which may be mentioned increased venous congestion below the diaphragm caused by the greater intra-abdominal pressure of pregnancy, obstruction in the common iliac veins, owing to the rush of blood from the enlarged hypogastric veins, disturbed vaso motor conditions, increase in the total amount of blood and consequent enlargement of the veins to accommodate this increase. Heredity plays an important role in the development of varicose veins.

Weight Changes and Water Retention in Pregnancy. One of the most notable alterations in pregnancy is the gain in weight. The enlarging uterus, the growing foetus, the placenta, liquor amnii, acquisition of fat and water retention all contribute to this increase in weight. The average increase varies in individuals. In general, the range of weight gain is on the average between 5 and 9 kg. The rate of gain varies according to the maturity of pregnancy. In the first three months, there may be no substantial gain, especially if there has been vomiting and anorexia. The middle trimester has a steady gain of nearly $\frac{1}{2}$ kg. a week amounting to a total of 3.5-5.5 kg. This is the period of steadiest progress though variations either way are not infrequent. During the last three months, there is an increase of 3.5-4.5 kg. and prior to labour a drop of 0.5-1.5 kg. occurs. The wide variation of weight which occurs both in normal and toxæmic patients is chiefly seen in the last three months of pregnancy. If allowance is made for all the tangible factors in pregnancy tending to increase the weight, there still remains a significant fraction, about a third of the total gain, to be accounted for and this is probably due to retention of water and deposition of fat and protein. The chief variations from the normal weights fall into this category and of the three items, the most variable is the amount of retained fluid.

The total body water may increase by as much as seven litres, and in late pregnancy the kidney may have some difficulty in disposing of the surplus water ingested. Hytten & Leitch (1964) have made theoretical estimates of the distribution of water in the various tissues

associated with the reproductive process and have compared them with measurements of the actual total body water. The measured average gain in total body water in their patients (gaining 12.5 kg in body weight) amounted to 7000 g. while only 5800 g. could be accounted for on theoretical grounds. They postulated that the difference of 1200 g., which appeared only in the last ten weeks of pregnancy, was attributable to an increase in extracellular fluid. Little direct evidence is available at present on the partition of water in the various body compartments during pregnancy. It is recognized that the partition might be affected by nutritional status.

The weight before pregnancy exerts an influence on the total net gain. In general the average woman gains 10 per cent of her original weight. Initially heavy women are liable to gain rather more than small and thin women. Extremes of feeding in either direction influences weight gain. A high carbohydrate intake will tend to produce fat, while a high protein diet by its specific metabolic stimulus may prevent excessive laying down of fat. The increased water retention in pregnancy is of great importance. That moiety of retained water which dilutes the blood volume is of special clinical importance in so far as it will influence all estimation of the constituents of blood, especially hæmoglobin. Greater importance is attached to the additional amount of water retained in the extracellular tissues, namely interstitial water. Interstitial water is the variable moiety of body water and forms about 25% of the whole body water. It is capable, during the latter half of pregnancy, of enormous and rapid changes. This extracellular water is increased during pregnancy right up to delivery, especially during the last three months. Nearly half of this increase is lost in the first week of puerperium.

Extracellular sodium is osmotically active and will partly control the distribution of water between the cells and extracellular spaces. The bulk of all the sodium chloride in the body is held in the extracellular fluid and in pregnancy there is increased sodium retention due to high level of circulating œstrogens and other steroids.

Water is lost continuously to the environment and is replenished at irregular intervals. There is no known norm for its behaviour and estimates of its mean value can only be approximate. Conventionally the total body water of a healthy young woman is 52 per cent of body weight. Recent studies using modern techniques by various authors have shown that in pregnant women with no clinically evident œdema there is an average gain of total body water of 6.8 litres, those with œdema of legs 7.2 litres and those with generalised œdema 9.8 litres. The general average is about 8.5 litres. The difference in behaviour between the groups might suggest that the first two are normal and the third abnormal. Clinical opinion about the importance of œdema

in pregnancy is divided. Evidence is accumulating which shows that women with œdema have slightly heavier babies than those without and the incidence of prematurity as birth weight of 2500 g. or less, is less and that there is no increase in perinatal mortality. It would appear that such œdema is physiologically normal and that in normal pregnancy there are two types of œdema—one that is affected by gravity and one that is not.

Oedema of the ankles and legs may be often seen during pregnancy. This usually appears towards the evening and disappears within a few hours of rest. It is largely due to increase in the venous pressure of the blood in the extremities which generally occurs during gestation. Many factors influence water retention : the steroid hormones, pituitrin, corticosteroids, tissue tension, venous pressure. The exact mechanism and resultant changes are complicated and require further elucidation. As a result of hydræmia in pregnancy, there is a lowering of hæmoglobin level, though there is actually an increase in the total hæmoglobin content. Some term this 'physiological anæmia' of pregnancy.

Basal Met. bolic Rate. Systematic observation of the B.M.R. shows a drop to around 10% in the third and fourth months. This drop is followed by a consistent rise of $\frac{1}{2}$ % every three weeks until it reaches 5% to 10% at term.

The Respiratory System. As the uterus increases in size and presses on the diaphragm, the lungs are naturally displaced. The diaphragm is pushed up, the respiration becomes more costal than abdominal, and in some cases it may be deeper and more frequent. The vital capacity remains unchanged and the respiratory rate rises relatively little in pregnancy.

Certain changes in the nose and throat are said to be characteristic. The turbinated bones are turgid and thickened and may sometimes close the nares. The larynx is somewhat congested and the voice may be affected.

Digestive System. During the early weeks of pregnancy, in the first trimester, minor disorders of digestion are not infrequent. Nausea and vomiting, spoken of generally as morning sickness, start about the sixth week and usually continue to the twelfth week. In some cases they may start much earlier, even during the second week, and persist for a much longer time. Vomiting may sometimes be so exaggerated as to be termed *Hyperemesis gravidarum*. Occasionally it may occur even in the later weeks of pregnancy. It is more prominent in primigravidæ. There is increased salivation and a tendency to constipation.

The liver is the seat of marked changes during pregnancy. The whole organ is enlarged and hyperæmic. There appears to be a definite decrease, if somewhat slight, in the functional capacity of the liver. The stomach is displaced in the later months of gestation, being forced upwards, backwards and to the left. The intestines are also affected; hæmorrhoids are common, partly due to the constipation and partly to the increased venous pressure below the diaphragm.

Urinary System. During pregnancy, changes in the urinary tract are observed. In the early months, a slight irritability of the bladder is commonly noticed till the uterus rises out of the pelvis. Ureteral dilatation, particularly on the right side and above the pelvic brim, is noticed after the middle of pregnancy. The hypertrophy of the lower ureteral musculature is induced by œstrogen and may cause constriction of the pelvic portion of the ureter and thus bring about dilatation above the constricted area.

Impairment of the ureteral drainage also is likely to occur due to increased angulation of that portion of the ureter which is adjacent to the cervix. Intravenous pyelogram studies have shown a marked dilatation of the pelvis of the kidney which favours the development of pyelitis which is not unusual as a complication of pregnancy.

The glomerular filtration rate is considerably increased in pregnancy as are the clearances of several substances (e.g. creatinine, urea, uric acid). The capacity to handle a water load, changes with unusually high rates of excretion in mid pregnancy and very low rates in late pregnancy. Glycosuria is common.

The Skeleton, Skin and Teeth. During pregnancy the bones show increased vascularity. The various pelvic joints become more mobile and sometimes they may become so relaxed that locomotion is not comfortable. The skin is much affected and pigment is deposited in certain definite areas—the nipples, the Vulva, the linea alba, the navel and the face. In some women the pigmentation is much more marked than in others. The teeth are prone to decay, and this is perhaps due to a deficiency in the calcium content resulting from the increased demand for it by the growing fœtus.

Nervous System. The nervous system is in a more excitable condition in the pregnant woman. Temperamental changes are not infrequent. Melancholia and real psychosis may develop, especially in those with a familial tendency.

Biochemical Changes. The important changes are :

(a) *Serum proteins.* There is a lowering of serum proteins in pregnancy usually due to hydræmia and this occurs in the last trimester of pregnancy. The following table gives the average in the non-pregnant and pregnant women:

	Protein	Albumin	Globulin	α_1	α_2	β	γ
Non-pregnant	7.19	3.78	3.41	0.30	0.67	0.89	1.46
Pregnant	6.46	2.44	4.02	0.49	0.88	1.22	1.43

It will be observed from the table given that there will be a reduction of about 1 gram in the total proteins and that the drop is more in the albumin fraction. The albumin globulin ratio is thus altered. It has been noted by observers in western countries that there is a drop in gamma globulin levels in normal pregnancy at term. Our findings do not support this and we do not find any drop in gamma globulin level in the class of patients dealt with by us.

(b) *Fibrinogen.* Blood Fibrinogen is said to increase in pregnancy especially as term approaches. The fibrinogen level in the non-pregnant is on an average 260 mgm. per cent.

In pregnancy, at term, the average value is 388 mgm., the range being 288-576 mgm. per cent. Thus there is increased fibrinogen level in pregnancy.

(c) *Serum iron and iron binding capacity of the serum.* Investigations reveal that there is in pregnancy a tendency for serum iron levels to be lowered especially after the 24th week, with an increase in the total iron binding capacity of the serum. The value of serum iron and total iron binding capacity of the serum in the non-pregnant and in the pregnant in the last trimester are given below. The significance of this finding will be discussed under 'Anæmia in Pregnancy'.

			Serum iron in μg per 100 ml.	TIBC in μg per 100 ml.
Non-pregnant	..	..	100.2	332.1
	Range :	..	125 - 70	406 - 229
Pregnant	..	..	75.8	399.3
	Range :	..	120 - 33	644 - 278

The Endocrine System. Perhaps the most remarkable changes in pregnancy occur in the endocrine system. Their full significance is not yet clearly understood. These glands play a dominant part in the physiology of pregnancy, and they will be described in detail in the chapter on 'Endocrinology in Obstetrics'.

DIAGNOSIS OF PREGNANCY

ALTHOUGH in most cases the diagnosis of pregnancy is fairly simple, sometimes in those very cases where a positive diagnosis is of the utmost importance, difficulties may be encountered which make it impossible to arrive at a definite conclusion. A number of signs and symptoms taken together generally helps in arriving at a positive diagnosis of pregnancy; and in the latter part of pregnancy, single signs may render the diagnosis probable or even positive. It is, however, judicious to be reserved in the expression of one's opinion, if there is any doubt as to the condition.

The signs and symptoms of pregnancy vary with the different periods of pregnancy, and can be classified under three periods or trimesters, namely, the first, second and third trimesters of pregnancy.

First Trimester

Subjective Symptoms. These are :—

- (1) Amenorrhœa.
- (2) Morning sickness.
- (3) Salivation, changes in disposition.
- (4) Irritability of the bladder.

Amenorrhœa. In normally menstruating women exposed to the risk of pregnancy, amenorrhœa may be the first warning symptom. This is not wholly reliable as amenorrhœa may result from chronic debilitating diseases, emotional stress lactation and other factors. Further it is possible to have small cyclical bleeding for a couple of cycles even though pregnancy has occurred. The cyclical bleeding can occur either from the non-pregnant horn of a bicornuate uterus or a uterus didelphys. It can also occur from a normal uterus till the decidua vera and capsularis become fused about the 10th-12th week. Pathological lesions in the genital tract also may give rise to bleeding during pregnancy.

Morning Sickness. Nausea and vomiting are usually associated with pregnancy in the early weeks. Morning sickness generally begins about the fourth to the sixth week of pregnancy and may continue till about the sixteenth week. Usually it is present in the

early hours of the morning and shows signs of abatement as the day progresses. In some cases, however, sickness may continue throughout the day. Sometimes nausea is more persistent than vomiting; occasionally we have seen cases of nocturnal vomiting, the patient feeling comfortable till evening when she begins to have a feeling of nausea, and vomiting occurs during the night. In some cases there may be no morning sickness.

So long as it does not affect the general health, morning sickness is a physiological phenomenon associated with pregnancy. Occasionally it may become a pathological symptom, when the nausea and vomiting may become so excessive as to prevent the possibility of any nourishment being retained or even taken by the patient. This is called *hyperemesis gravidarum*. Vomiting may, however, be due to other causes referable to the gastro-intestinal tract, or other organs.

Salivation and Changes in Disposition. Salivation is an early symptom and is pronounced in certain cases. The changes in disposition may be shown by a change in the temperament, resulting in the patient becoming irritable and capricious. She may evince a desire for articles of food quite at variance with her ordinary habits. These have been termed the longings or *pica* of pregnancy; they are not of diagnostic value, as they are purely subjective and may occur in various neurotic conditions.

Irritability of the Bladder. Frequency of micturition is sometimes complained of, and is due to the pressure exerted on the bladder by the growing uterus. As the uterus increases in size and becomes an abdominal organ, this pressure is relieved and the symptom gradually disappears.

Objective Signs. These are :—

- (1) Changes in the breasts.
- (2) Bluish discoloration of the vulva and the vagina.
- (3) Softening of the cervix and the vagina.
- (4) Changes in the shape, size, position and consistency of the uterus.
- (5) Hegar's sign.

Changes in the Breasts. Changes in the breast are marked particularly in *primigravidæ*. There is a general enlargement of the organ, with prominence of the veins and pigmentation forming the characteristic primary and secondary areolæ. The nipples also become more prominent, erectile and turgescient; Montgomery's follicles appear first on the primary areolæ and later on the secondary areolæ. The

secondary areolæ develop from the fifth month onwards, while the other changes generally take place during the first trimester—from the fourth to the twelfth week of pregnancy. The presence of a little fluid in the breast can usually be detected from the twelfth week onward by gently squeezing the breast in the direction of the nipple. The fluid is clear and contains some colostrum corpuscles.

While breast changes are constant in pregnancy, they may also be brought about by certain other pathological conditions of the uterus and ovary. In multiparæ the changes in the breasts are not of much diagnostic value, because pregnancy may take place in a lactating woman, while pigmentation of the areola and milky secretion in the breasts may persist after a previous pregnancy. While the absence of these signs does not prove the non-existence of pregnancy, their presence cannot help us to a positive conclusion unless supplemented by other signs.

Bluish Discoloration of the Vagina. This sign is generally detected between the fourth and eighth week of pregnancy, and it increases in intensity up to the sixteenth week, when it has perhaps reached its maximum. It persists throughout pregnancy. The vulva and vaginal mucous membranes, consequent upon the congestion of the blood vessels, present a violet or light blue tint, and later a purplish or deep blue tint. This sign was first described by Jacquemier, and later emphasised by Chadwick, and is therefore known as *Jacquemier's sign* or *Chadwick's sign*.

Besides this discoloration there may be a sensation of increased warmth in the genitalia resulting from the augmented blood supply to those parts. At a later stage increased vaginal pulsations may be noticed, and this sign is sometimes spoken of as *Osiander's sign*. This may, however, be produced in non-pregnant conditions, such as fibroids and pelvic inflammations, and cannot therefore be depended on for a diagnosis.

Uterine Changes. The uterus is perhaps the most important organ to undergo remarkable changes due to pregnancy. In the early weeks of pregnancy changes in size, shape and position occur. These can be made out by bimanual examination, either by the abdomino-vaginal or the abdomino-rectal method of palpation.

The virgin uterus is pyriform or pear-shaped, and usually ante-flexed. During the first eight to ten weeks of gestation the organ loses its pear-shape and gradually becomes rounded or globular and more ante-flexed. The uterus in the early weeks of pregnancy lies within the pelvic cavity. After the twelfth week it rises gradually upwards towards the abdomen.



FIG. 13. — Bluish discolouration of the vagina.



FIG. 14.—*Striae gravidarum.*



FIG. 15.—*Breast changes in pregnancy.*

Alterations take place in the consistency of the organ and it becomes much softer. The softening is particularly noticeable in the cervix and the lower uterine segment. This softening of the cervix is an important sign and can be recognised from the fourth

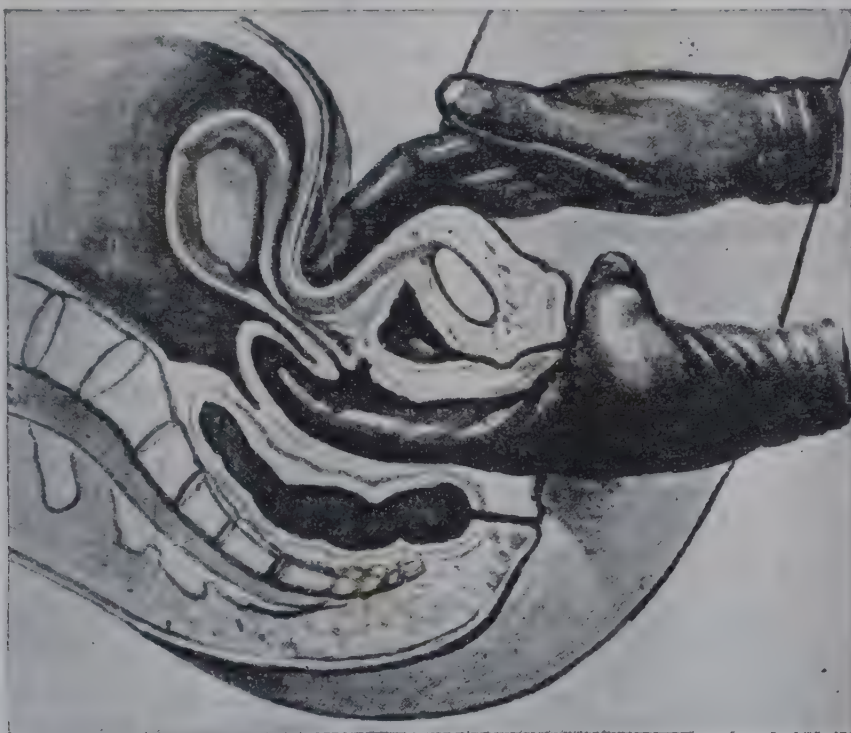


FIG. 16.—Method of eliciting Hegar's sign.

week onwards. The comparison has been made that the cervix, in the non-gravid condition, is as hard as the tip of one's nose, and that in pregnancy it becomes as soft, as one's lips or the lobe of the ear.

Softening and compressibility of the isthmus or lower uterine segment constitute what is known as *Hegar's sign*. This is of great value and has been observed from about the sixth or eighth week to the twelfth week of pregnancy. This sign is more difficult to recognise in multiparæ than in primiparæ, but when definitely present constitutes one of the most valuable of physical signs in the recognition of pregnancy at this period.

Hegar's sign can be elicited in several ways:—

(1) In women with a lax abdominal wall and a roomy vagina, two fingers are introduced into the vagina and passed posteriorly behind the cervix, while the fingers of the other hand are pressed down into the abdomen from above the symphysis pubis. The fingers of the two hands will almost meet as if there was no resisting tissue in between and the cervix and body of the uterus will appear as two independent masses.

(2) In other cases, two fingers could be passed into the anterior fornix. The fingers of the other hand are placed above the symphysis

behind the body of the anteflexed uterus and pressed downward to meet the vaginal fingers. Because of the danger of causing an interruption of pregnancy, these manipulations must be gentle and pressure over the body of the uterus must be avoided. No attempt should be made to elicit Hegar's sign after the third month of pregnancy.

Second Trimester

Subjective Symptoms. During this period certain of the signs and symptoms that were present in the earlier periods of pregnancy gradually disappear and other signs and symptoms become apparent. Morning sickness, increased salivation and frequency of micturition generally disappear by this time. An important symptom that may be felt during the second trimester is *quickening*. The active fœtal movements are generally first felt by the mother at the end of the sixteenth week, and the term *quickening* is applied to the first recognition. This movement of quickening has been compared to the fluttering of a bird imprisoned in the hand. The movements become more vigorous and may sometimes be painful. They may cease entirely in some cases although the fœtus continues to be alive. Their sudden and complete cessation, however, is suggestive of death of the fœtus *in utero*. Fœtal movements may be mistaken for peristaltic movements of the intestines.

The date of 'quickening', if definitely ascertainable from the patient, is important for purposes of reckoning the period of pregnancy and calculating the probable date of delivery.

Objective Signs. The objective signs of this period of pregnancy are of extreme importance, as they furnish a definite and reliable guide to the positive diagnosis of pregnancy. These signs in the second trimester are :—

- (1) Changes in the skin.
- (2) Changes in the size of the uterus.
- (3) Intermittent uterine contractions.
- (4) Active fœtal movements.
- (5) Palpation of the fœtal parts.
- (6) Auscultatory signs.
- (7) Passive fœtal movements.

Changes in the Skin. Pigmentation is one of the characteristic changes that take place in pregnancy. This is more marked in the forehead and cheeks in the form of dark brown patches noticed more particularly in brunettes. Pigmentation and striæ may also be seen

on the breasts and over the abdominal wall. A linear pigmented area stretching from the umbilicus to the symphysis pubis is of deeper colour and is known as the *linea nigra*. On either side over the abdominal wall are other striæ, whitish in appearance and spoken of as *linea albicantes*.

Changes in the Shape and Size of the Uterus. The uterus, being a progressively growing organ in pregnancy, gradually increases in size, becomes ovoid in shape, and can be felt at different levels in the abdomen in successive periods of pregnancy.

Intermittent Uterine Contractions. This is known as *Braxton-Hick's sign*, and it is found irrespective of whether the fœtus is alive or dead. It may be detected by palpation as early as the sixteenth week. These contractions as a rule occur throughout pregnancy at fairly long intervals and last for a few seconds. They may be easily elicited by keeping the hand in full contact with the abdominal wall over the uterus, when the gradual relaxation and contraction of the uterine musculature will be felt.

Active Fœtal Movements when felt, seen or heard afford positive evidence of pregnancy and of a live child. They may be noticed after the sixteenth or eighteenth week of pregnancy, but more generally during the last trimester.

Palpation of the Fœtal Parts. About the middle of pregnancy the fœtus is generally increased to a size when it can be recognized by abdominal palpation. As pregnancy progresses this sign is of great value, not only in detecting pregnancy but also in ascertaining the various positions of the fœtus *in utero*.

Auscultatory Signs. Auscultation over the abdominal wall during pregnancy is useful to elicit various sounds, some of which are of great importance in the positive diagnosis of pregnancy.

(a) *The Fœtal Heart.* The fœtal heart can be heard about the sixteenth week of pregnancy and resembles the ticking of a watch heard through a pillow. This is the only sign of pregnancy which by itself and in the absence of all others is perfectly reliable for the diagnosis of pregnancy. The point of greatest intensity of the fœtal heart sounds will vary with the position of the child *in utero*. Ordinarily the fœtal heart beats 130 to 150 times a minute.

(b) *The Funic Souffle.* This is a soft murmur synchronous with the fœtal heart-beat, heard rarely, and said to be an unfavourable sign, indicative of fœtal distress, if persistent. It is due to obstruction to the rush of blood through the umbilical arteries caused by compression of the umbilical cord through knots, twists or pressure by extrinsic factors.

(c) *The Uterine Souffle*. This is easily detected from about the sixteenth week, and is a soft blowing or musical murmur, synchronous with the maternal heart-beat. It may be heard, however, in conditions of uterine enlargement from causes other than pregnancy. It is due to the passage of blood through the dilated uterine vessels.

Other sounds that may be heard are due to the movements of the fœtus, intestinal movements, and contractions of the abdominal muscles themselves.

Passive Fœtal Movements. These may be elicited by internal or external manipulations, producing a passive movement of the fœtus *in utero*.

(a) *Internal Ballottement*. This sign may be obtained from the eighteenth week till about the twenty-eighth week of pregnancy. To elicit this sign the patient is placed in the dorsal posture, the index and middle fingers are introduced into the vagina and steadied against the lower pole of the fœtus, which is pressed down by the other hand over the abdomen. The fingers in the vagina give a sharp tap upwards. The impulse thus generated is transmitted to the fœtus which bounds upward and then after a moment falls back upon the examining fingers. If clearly elicited it must be considered as one of the most valuable signs of pregnancy at this period. Rarely, some pathological conditions may give rise to a very similar sensation; for example, a calculus in the bladder, a fibroid or ovarian tumour complicated with ascites; but in such cases no other sign of pregnancy will be present. Before the eighteenth week the fœtus is too small to respond to the digital impulse, and after the twenty-eighth week the fœtus is relatively too large, filling so much of the uterine cavity that it cannot be moved about as freely as formerly. This sign may not be elicited in conditions associated with a deficiency of the liquor amnii or where the fœtus is not presenting by the cephalic pole.

(b) *External Ballottement*. This sign is elicited with the patient in a recumbent position, by steadying the uterus with one hand applied to the side and gently tapping with the other hand from the opposite side, when the impact of the fœtal parts will be felt. It depends upon the amount of liquor amnii present in the uterine cavity. It may sometimes be elicited in cases of fibroids or ovarian tumours associated with ascites. It is difficult to elicit in cases where the abdominal wall is thick and fatty and in conditions where the liquor amnii is very much diminished in quantity.

Third Trimester

During this period of pregnancy the painless uterine contractions persist, the fœtal movements are more easily felt and seen, ballotte-

ment is generally not obtainable, foetal parts are easily palpable, while the foetal heart is well heard if the foetus is alive and the uterine souffle definitely made out. The uterus progressively enlarges till at term it fills almost the whole of the abdomen.

Biological Tests

The difficulty that sometimes arises in making a definite diagnosis of pregnancy, before any of the positive signs manifest themselves, has induced several workers to devise laboratory tests for this purpose.

Aschheim-Zondek Test. One of the most important of all pregnancy tests is the Aschheim-Zondek test. Aschheim and Zondek demonstrated in 1927 that the urine of pregnant women contained a hormone which had definite properties. This test is based upon the changes noticed in the ovaries of immature mice when the urine of pregnant women is injected into mice. These changes are dependent on the presence of chorionic gonadotrophic hormone in the urine which is secreted by the developing trophoblast in large amounts and excreted in the urine.

The test is performed as follows: Immature female mice, twenty-five to thirty days old, are used for this test. About 25 to 30 ml. of fresh filtered morning urine of the woman is taken and shaken up with 90 to 120 ml. of ether for three to five minutes, and the ether is then separated off. To the residual urine 0.9 gm. of glucose is added. The urine is injected into five mice in varying doses, from 0.2 to 0.4 ml. for two days, thrice daily. The injections are given as follows:—

Mouse 1	.	.	.	.	.	.	6 × 0.2 ml. of urine
2	.	.	.	.	.	.	6 × 0.25 -do-
3	.	.	.	.	.	.	6 × 0.3 -do-
4	.	.	.	.	.	.	6 × 0.35 -do-
5	.	.	.	.	.	.	6 × 0.4 -do-
6	.	.	.	.	.	.	Control—no injections

A positive reaction may always be expected within seventy-two hours. The abdomen of the mouse is opened and the ovaries examined. The following changes may be noted when the reaction is positive: the ovaries are enlarged and hyperæmic and on their surface may be seen small hæmorrhagic areas. The appearance is very characteristic, as there is marked tendency towards luteinisation, which may be noted by the presence of numerous corpora lutea.

The chief drawbacks of this test are the difficulty in having to maintain a large colony of suitable mice and the delay in obtaining the result.

For these reasons various modifications have been tried.

Friedman's Test. This test is carried out by injecting the urine intravenously into rabbits, and has the advantage that the technique is simpler and the results can be noted at an earlier stage—thirty-six to forty-eight hours.

The test is done as follows: Female rabbits, aged twelve to twenty weeks, which have been isolated for a period of three weeks are used. Two injections of 6 ml. of urine are given intravenously into the marginal vein of the ear daily for two days, and forty-eight hours after the first injection the peritoneal cavity is opened and the ovaries inspected *in situ*. The changes noted in the ovaries are characteristic; ovulation is easily recognized: either fresh corpora lutea or projecting corpora hæmorrhagica can be seen on the surface. Before the test is undertaken, it is essential to be certain that ovulation has not taken place recently and that the rabbits are not pregnant. It is to ensure this that the rabbits should be kept isolated for twenty days. The accuracy of this test is about 90%.

The Hogben Test. In 1934 Prof. Hogben showed that the *Xenopus* toad would respond to injected gonadotrophin by ovulation and oviposition. Since then the toad has been used as a common test animal in the diagnosis of pregnancy with great success.

Morning specimen of urine should be used. The hormone is extracted from the urine in a concentrated form by absorption with kaolin by a simple technique. 5 ml. of this concentrate is injected into the dorsal lymph sac of the toad. The toad selected should be mature female (differentiated from the male by the labia covering the cloaca). It should weigh between 60-100 grammes. It must respond by ovulation and oviposition to a dose of 70 I.U. of chorionic gonadotrophic hormone. The procedure ensures that toads used are all mature. The less sensitive ones can be discarded from use. The injected toad is placed in a glass jar fitted with a perforated platform. The jar is filled with water but not completely. The platform is very necessary as some toads eat their eggs. If the toad ovulates within 18 hours, the test is positive. If, however, no eggs are laid within 18 hours, a second toad is injected. If both toads do not lay eggs within 48 hours from the start of the test, it is recorded as negative.

Toads are injected every ten days as they are found to be more sensitive then than when used after 21 days. They are not however continuously used as they lose weight. Ordinarily they are used three times a month rested for one month and used again next month.

This test claims the same accuracy if not more than the A.Z. test—99.8 against 99.5 per cent.



FIG. 17—Friedman's test showing the ovaries before and after the test.

The male toad test—Galli Mainini Test. This test was introduced in 1947 and depends on the discovery that injections of chorionic gonadotrophin into male toad causes the expulsion of spermatozoa into the cloaca. 2.5 ml. of the urine is injected under the dorsal skin. The spermatozoa appear in the urine in 2-3 hours and latest within 24 hours. The urine is drawn off by a pipette from the cloaca and examined under the microscope for spermatozoa. The test gives an accuracy of 94-96 per cent.

The male frog test. The local variety—*Rana hexadactyla* and *Rana tigrina*, both of which are easily available—has, in our experience, given very satisfactory results. The technique is as follows :—

Frogs varying in weight from 14 gms. to 100 gms. are used. 5 ml. of urine is ordinarily used and this is injected into the dorsal lymph sac or subcutaneously. After the injection, the cloaca is aspirated every half an hour for the first $1\frac{1}{2}$ hours and later every hour for a total of five hours. With positive urine, the sperms appear in half an hour in 70% of cases and in the rest within three hours by which time the output of spermatozoa reaches a maximum. In rare cases, the sperms completely disappear by about four hours. A sperm count could be done in these cases. Ordinarily a positive test gives an average concentration of 1250 sperms per cmm. With vesicular mole, as many as 12,500 per cmm. have been noticed. There is only a rough correlation between the number of sperms and the concentration of the gonadotrophic hormone.

While in early pregnancy this test gives good accuracy, as the pregnancy enters the second trimester and beyond, the accuracy falls as the concentration of hormone in the urine drops. It is better then to use the urine concentrate. The hormone in the urine could be concentrated by extracting it with kaolin by a simple technique and 5 ml. of the concentrate can be used. We have used 5 ml. of the serum instead of urine. The concentrate is less toxic to the frogs and hence fewer frogs die. The frogs are used once in ten days and given a month's rest after three tests. Since they are easily available, we do not ordinarily use them for more than three or four tests. The accuracy of the test in our hands has been about 98% in the first trimester. Ordinarily a negative report can be given within five hours. The seasonal variations do not affect the accuracy of the test, and in the second and third trimesters, its accuracy is poor as compared to other tests.

A false negative reaction is occasionally due to insensitivity of the animal used, very low concentration of hormone in the urine or faults in technique. It is necessary that animals used should occasionally

be checked with injections of standard gonadotrophin to make sure of their sensitivity.

From the quantitative point of view the biological test has been utilised to diagnose the presence of hydatidiform mole and chorion epithelioma. In hydatidiform mole the chorionic villi take on extra activity, and much larger quantities of chorionic gonadotrophic hormone are excreted in the urine, giving a positive biological test in very high dilutions.

It must be however remembered that in normal pregnancy, the amount of gonadotrophic hormone in the urine increases rapidly to a sharp peak about 60 days after onset of last period. At this time the amount of hormone excreted is very high. For this reason, the value of bio-assays of urine for diagnosis of hydatidiform mole is limited at this period. However, a high excretion is most suggestive of hydatid mole.

A positive biological test obtained from the spinal fluid is of value where hydatidiform mole and chorion-epithelioma are suspected, particularly for early detection of chorion epithelioma and for recognition of metastasis before clinical signs and symptoms appear.

It is at times very difficult to differentiate between an early pregnancy and the amenorrhic phase in certain types of dysfunctional bleeding. In both conditions, there is a history of amenorrhœa with the uterus soft and slightly enlarged. Hegar's sign is absent in the condition and only a biological test may help in the final decision.

Other Methods of Diagnosis

(1) *The P.L. Test.* Cervical mucus shows arborisation when spread on a slide and left to dry. There is a fascinating pattern resembling fern or palm leaves (P.L.). During pregnancy the pattern of cervical mucus resembles that of the premenstrum with an abundance of cervical and vaginal cells, leucocytes and threads of mucus without any indication of arborisation (negative P.L. reaction). The negative P.L. reaction of the premenstrum can be changed to positive by injecting 10 mgm. of Oestradiol Benzoate; because 10 mgm. of Oestrogens inhibit the action of Progesterone. During pregnancy, however, even if Oestrogens are injected, no positive P.L. test is obtained as the cervical cells lose their ability to react to Oestrogens. In amenorrhic women the P.L. reaction is negative but if 10 mgm. of Oestrogen is injected, bleeding occurs in three to four days of injection but not if the amenorrhœa is due to pregnancy. The percentage of accuracy is nearly 99. The only disadvantage is the necessity for an injection and a delay of four to five days.

(2) *Oestrogen-Progesterone withdrawal bleeding.* Zondek in 1942 claimed that it was possible to produce uterine bleeding in cases of primary and secondary amenorrhœa by injection of Progesterone. Furthermore he stated that the dosage of Progesterone could be reduced by the addition of Oestrogens. These observations resulted in the trial of injecting Progesterone and Oestrogen as a means of diagnosing pregnancy.

A common technique now employed is to give two injections of 2.5 mgm. of Oestradiol Benzoate and 12.5 mgm. of Progesterone on two consecutive days. If the amenorrhœa is not due to pregnancy, withdrawal bleeding usually occurs in 2-5 days. The accuracy of this test is about 99%. There are some who consider this test more accurate than Hogben's test, especially in the early weeks. This test indicates gestation within fourteen days from the first day of the missed period. Many of the false negatives in the biological tests are in this period. At present it would appear that the withdrawal bleeding test is a very simple, accurate and useful method. Its only disadvantage is the delay of four to five days.

(3) *The Immunologic test.* Attempts to identify chorionic gonadotrophin (HCG) by methods other than animal assay were unsuccessful until the recognition of the specific antigenicity of the protein hormones. This observation permitted the successful utilisation of immunological techniques for the detection of HCG and several immunological procedures have been reported.

In the presence of HCG antiserum red blood cells coated with HCG will agglutinate and settle out to form a mat of cells at the bottom of a test tube. When HCG in the urine of a pregnant woman is added to this system inhibition of the combination of coated cells and antibody takes place. The result is a 'dough nut' pattern of cells equivalent to that seen in the control. This is a positive pregnancy test. The urine of non-pregnant women containing no HCG does not inhibit the hæmagglutination reaction. A mat of cells with or without a faint ring then develops. This is a negative pregnancy test.

The procedure :—

The urine is filtered into a clean vial and diluted with two parts of isotonic saline. The control tube is designated as Tube I and the reaction tube is Tube II. To tube I add 0.25 ml. of the diluent which is normal rabbit serum in isotonic saline and to tube II 0.25 ml. of anti-serum. To each tube 0.25 ml. of diluted urine is then added. 0.05 ml. of a suspension of sheep erythrocytes sensitised with HCG is then added to each tube. The tubes are mixed to provide a uniform suspension of cells and left undisturbed at ordinary room temperature

for two hours at which time patterns develop on the bottom of each tube.

This test requires no animals and special equipment. It is a rapid specific test and is reliable as early as 30 days after the onset of the last menstrual period. Its overall accuracy is about 98%.

Various modifications of this test have since been perfected but the principle involved is the same.

A simple, rapid, commercially available test based upon inhibition of agglutination employs polystyrene latex particles coated with a purified preparation of human chorionic gonadotrophin (HCG) as the antigen and anti-serum to HCG. A drop of anti-serum is thoroughly mixed with a drop of urine on a glass slide for 30 seconds ; two drops of the sensitized latex particles are then added and mixed thoroughly with the combination of antiserum and urine. The slide is gently agitated for up to two minutes. Visible agglutination during this time is a **NEGATIVE** test for pregnancy. Absence of agglutination indicates neutralization of the antiserum by gonadotrophin in the urine and is therefore a **POSITIVE** test.

Radiological Diagnosis

The foetal skeleton can be made out in a good radiograph as early as the 16th-18th week and when seen is conclusive evidence of pregnancy. Radiography is not of use prior to 16 weeks. Realisation of the hazards of radiation in pregnancy has made the Obstetrician restrict its use considerably especially in early pregnancy.

Ultrasonics

Ultrasonics by the pulse-echo Sonar method is now being widely applied for diagnostic purposes in Obstetrics. By this method early pregnancy as early as six weeks, multiple pregnancy, vesicular mole and many other important factors about the foetus and placenta can now be diagnosed with very great accuracy and without submitting the patient to the hazards of radiation. In some clinics in the world ultra sound techniques have become routine procedures in obstetric diagnosis because of its accuracy and harmlessness. However the equipment is costly and requires the assistance of well trained personnel.

DIFFERENTIAL DIAGNOSIS OF PREGNANCY

PREGNANCY may have to be differentiated from other conditions which produce an enlargement of the uterus. Among conditions which may lead to an error in diagnosis in the *early months of pregnancy* may be mentioned :—

- (1) Amenorrhic phase in dysfunctional uterine bleeding.
- (2) Hæmatometra.
- (3) Interstitial or submucous fibroids.

Hæmatometra is a condition caused by the retention of menstrual fluid in the cavity of the uterus as a result of closure of some portion of the cervical canal, either at the internal os or the external os or in the cervical canal itself. The accumulation of the fluid causes a uniform enlargement of the uterus and the tumour increases in size periodically, accompanied by pain and tenderness. It is associated with amenorrhœa, but a careful examination will detect the obstruction and the nature of the uterine enlargement. These findings, together with the history of the case, will reveal the diagnosis.

Fibroid tumours of the uterus, particularly interstitial fibroids, may occasionally give rise to a uniform enlargement of the uterus, and in some cases, owing to changes in the ovaries, they may be associated with amenorrhœa. The absence of Hegar's sign, and the early symptoms of pregnancy, such as salivation, morning sickness, together with the comparatively harder feel of the uterus, may serve to put one on guard in considering the diagnosis. Occasionally a gravid uterus has been mistaken for a fibroid, and a laparotomy performed. Even after opening the abdomen it may be difficult to differentiate between a fibroid and pregnancy. A simple test will help to settle the diagnosis. The needle of a hypodermic syringe is passed into the enlarged uterus, and in cases of fibroids the needle will enter with some degree of resistance ; while if it is pregnancy, the needle will slip in more easily and clear fluid (liquor amnii) can be withdrawn. This is one way of differentiating between fibroid and pregnancy, and is valuable in those cases where pregnancy is also complicated by fibroids.

A valuable aid in the differential diagnosis is the biological test already referred to. If the pregnancy has advanced to nearly sixteen weeks, radiographic examination will be of great help.

In the latter half of pregnancy the condition may have to be diagnosed from ovarian cysts and uterine fibroids.

A careful study of the history and abdominal and pelvic examination will usually decide the diagnosis. A tumour unconnected with the uterus made out on clinical examination is usually ovarian in origin. A uterine swelling with palpable fœtal parts and audible fœtal heart is diagnostic of pregnancy. Pregnancy may co-exist with fibroids or ovarian tumour. Diagnosis may be rendered difficult and X-rays and biological tests will help to confirm the diagnosis. This will be discussed further in the chapter on 'Tumours Complicating Pregnancy'.

Pseudocyesis. This condition may occur in women who have an intense desire to become pregnant. Most frequently it is observed in a woman who is approaching the menopause when her menstrual flow has become scanty or has ceased for a time. A deposit of fat takes place in the anterior abdominal wall and omentum and the intestines become distended with flatus. In such cases several of the doubtful signs and symptoms of pregnancy may be present; for example, menstruation may cease; the mammary signs of gestation may appear and the abdomen may become progressively prominent; the patient may imagine that she feels fœtal movements; striæ may appear both on the abdomen and breasts. In some cases the condition may go on and eventually spurious labour may set in.



FIG. 18.—Pseudocyesis.

The diagnosis of this condition is not difficult, but the physician should be on guard in assessing any statements the patient may offer in regard to her condition. An examination, under anæsthesia will help.

An X-ray is useful in such cases; needless to say the biological test will invariably be negative.

Diagnosis between First and Subsequent Pregnancy. In the large majority of cases it is not difficult to diagnose whether the patient is pregnant for the first time or has had children previously. In some cases where the woman has had an abortion, or a premature delivery, the signs may not be quite characteristic. The following are the points for consideration:—

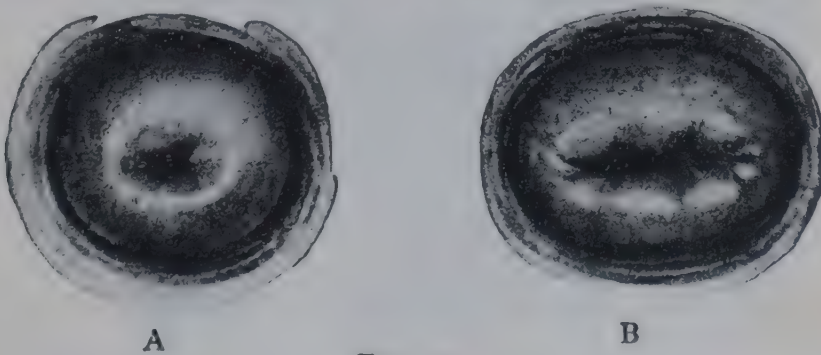
(1) *The Breasts.* In a primigravida the mammary gland is firmer, fuller and the areola and Montgomery's follicles are more prominent. In a multipara the breasts are more flabby and pendulous, with old white striæ and prominent nipples.

(2) *The Abdominal Wall.* This is more relaxed and easily thrown into folds in a multipara and the striæ may be much more prominent. Striæ may, however, occur in other conditions, causing rapid distention of the abdomen, such as ascites, ovarian cysts or adiposity.

(3) *The Vagina.* In virgins the hymen is intact, unless there has been any surgical interference sufficient to cause its rupture. In a nulliparous woman the hymen is usually torn, but its remains can be readily made out. In a parous woman, on the other hand, the hymen has almost entirely disappeared and is only represented by warty prominences known as *carunculæ myrtiformes*. There are, however, rare cases where an elastic hymen has stretched to such an extent that even after child-birth it is present. Besides the hymen, in a nulliparous woman the fourchette and the perineum are intact. In a parous woman, on the other hand, the fourchette has almost invariably been torn and the perineum may show evidence of previous laceration.

In a nulliparous woman the vaginal mucous membrane is rugose, but in a parous woman the rugæ have disappeared and the vaginal orifice is larger and may be gaping.

(4) *The Cervix.* One of the important signs of parity is found in the condition of the cervix. In a nulliparous woman the external



A. Cervix in a nulliparous woman.

B. Cervix in a parous woman.

Note the transverse slit and the irregular cicatrices.

os is circular, the mucous membrane smooth and intact and the orifice closed. In a parous woman, on the other hand, the orifice is a transverse patulous slit and may admit the tip of the finger. In certain conditions where a premature labour or abortion has occurred, the

cervix may not show the characteristic signs ; on the other hand, as a result of operative manipulations, the cervix of a nullipara may be torn and resemble a multiparous cervix.

The Duration of Pregnancy. The period of gestation may be ascertained by :—

- (1) The period of amenorrhœa ;
- (2) The height of the uterus ;
- (3) The measurements of the fœtal ovoid in certain cases ; and
- (4) The date of ' quickening ', if it can be ascertained reliably.

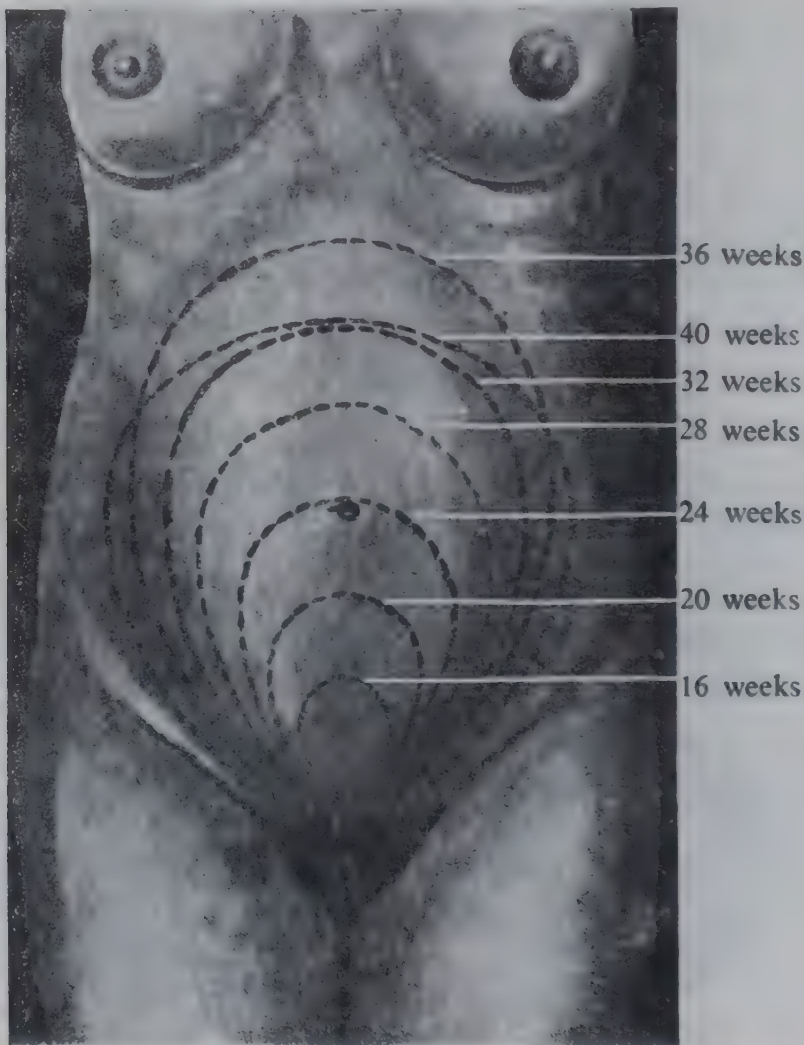


FIG. 20.—The heights of the uterus at varying periods of pregnancy.

(1) *Amenorrhœa.* The usual period of pregnancy may, for all practical purposes, be taken as ten lunar months, or 280 days, calculated from the first day of the last menstrual period. The difficulties in regard to this are that occasionally the date of the last period may not be ascertainable, or conception has occurred during a period of amenorrhœa, following a previous confinement or due to certain diseased conditions. In some rare cases the menstrual flow may occur

once or twice after the commencement of pregnancy before amenorrhœa is established.

(2) *By the Height of the Uterus.* Under normal conditions the uterus enlarges uniformly and its height is proportionate to the period

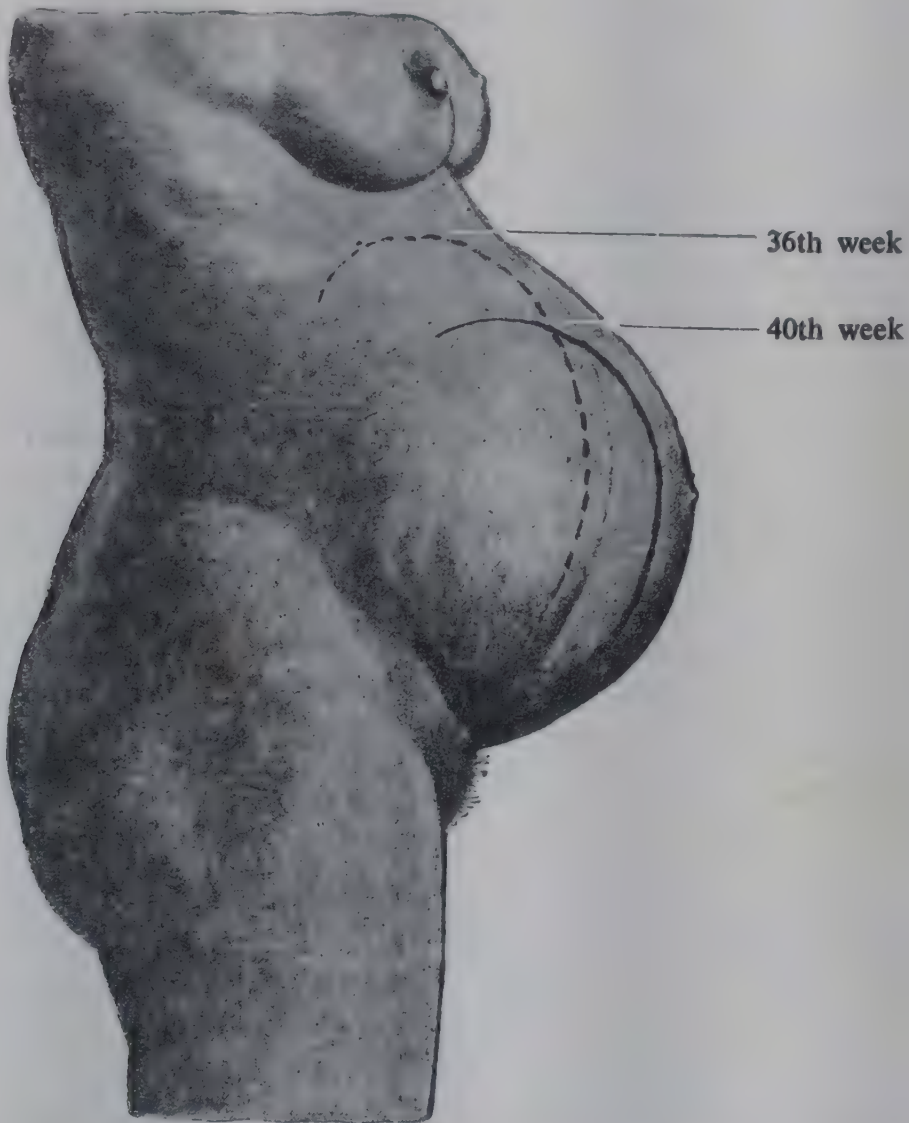


FIG. 21.—The heights of the uterus at the 36th and 40th weeks of pregnancy.

Note the falling forward of the fundus at the 40th week.

of pregnancy. It is more or less a pelvic organ up to twelve weeks and from then onwards gradually rises into the abdomen. The height of the uterus according to the period of gestation is as follows :—

16th Week. Just palpable above the symphysis pubis.

20th Week. Midway between the umbilicus and the symphysis pubis.

24th Week. Up to the level of the umbilicus.

28th Week. 'Three fingers' breadth above the level of the umbilicus.

32nd Week. Midway between the umbilicus and the ensiform cartilage.

36th Week. Almost at the level of the ensiform cartilage.

40th Week. At the level of the uterus at the 32nd week, but there is a falling forward of the fundus.

The calculation of the period of pregnancy from the height of the uterus may be vitiated by certain conditions. The height of the uterus is usually smaller when compared to the period of amenorrhœa in cases of ectopic gestation, retroverted gravid uterus, intrauterine death of the fœtus and oligo hydramnios. On the other hand, it is larger in vesicular mole, hydramnios, multiple pregnancy, concealed accidental hæmorrhage and in tumours complicating pregnancy.

(3) *The length of the fœtal ovoid* can be directly measured during the second half of pregnancy by calipers, one blade of which is placed over the lower pole of the fœtus and the other over the upper pole near the fundus of the uterus. The length of the fœtal ovoid gives some idea of the period of gestation. By doubling the measurement thus obtained in centimetres and subtracting 2 cm. for the thickness of the soft parts, one arrives at the length of the fœtus and from this may be deduced the period of pregnancy. After birth, however, the age can be ascertained by direct measurement of the length of the fœtus.

An easy rule that may be applied after delivery is as follows : ascertain the length of the fœtus in centimetres, and note that the length is generally the square of the number of the lunar month up to the fifth month, and thereafter it is obtained by multiplying the number of the month by 5. Thus, at the fourth month, the length will be 4×4 or 16 cms. ; at the seventh month, 7×5 or 35 cms.

(4) *From the Date of 'Quickening'.* Quickening generally occurs about the eighteenth week of pregnancy, and if it can be definitely ascertained, as in multiparæ, the probable period of gestation may be calculated.

How to Calculate the Probable Date of Confinement

(1) *From the Date of the Last Normal Menstrual Period.* Get the actual date of the first day of the last menstruation, add seven days, and count back three months. If a leap year intervenes, add six days only. For example, if the first day of the last menstrual period be 1st October, add seven days, which brings us to the 8th of October,

and count back three months, which brings one to the 8th of July. The 8th of July of the succeeding year will then be the probable date of confinement.

(2) *From the Date of 'Quickening'.* If this can be ascertained definitely, add twenty-two weeks to the date of quickening, which gives the probable date of confinement.

(3) *From the Height of the Uterus.* An approximate idea may be obtained about the probable date of confinement by noting the height of the uterus. Prior to ascertaining the height of the fundus, the bladder must be emptied, the patient in a recumbent position, and the uterus not contracting at the time of palpation. In all cases where the height of the uterus is approximately that found at the thirty-second week, the patient must be made to sit up to see if there is any falling forward of the uterus, so as to ascertain whether it is the thirty-second or the fortieth week of pregnancy.

Where the lie of the fœtus is oblique the consequent change from the normal contour of the uterus gives rise to some error in the calculation of the probable date of confinement. In cases where the gravid uterus is pushed to one side, generally to the right, the height of the fundus should be ascertained after bringing it to the median position.

(4) *Fixation of the Head.* In normal pregnancy where the pelvis is normal and the fœtus is presenting by the vertex, the head generally becomes fixed two or three weeks before the onset of labour in a primigravida and just prior to the onset of labour in a multipara. Fixation of the head, therefore, is an aid in calculating the probable date of confinement in both classes of cases.

Thus though these are many methods of estimating the probable date of confinement there is at present no method of accurately forecasting the correct date.

THE FŒTUS IN NORMAL PREGNANCY

THE fœtus is one of the important factors concerned in labour, and it is necessary to appreciate correctly the part it plays in the mechanism of labour.

Attitude. The attitude of the fœtus is the relation of the fœtal parts to one another. Ordinarily the fœtus assumes the attitude of universal flexion, thus forming an ovoid mass corresponding roughly to the shape of the uterine ovoid. By this means the space occupied by the fœtus is reduced to the minimum, and it will be seen later that this attitude of universal flexion has an important bearing upon the mechanism of delivery. The spinal column is bent forward, the head is flexed, the chin resting against the sternum, the arms are flexed and folded across the chest, the lower extremities are flexed, so that the thighs are on the abdomen and the legs bent at the knee joint resting on the thighs with the feet crossed in an attitude of dorsiflexion.

When the fœtal ovoid in this attitude of universal flexion lies longitudinally in the uterine ovoid the uterus is subjected to very little stretching. In such a position the fœtus may have either the head or the breech at the lower pole of the uterus.

Presentation. By presentation is meant that portion of the fœtal ovoid which is in relation to the lower pole of the uterus and is the first to engage in the pelvis when labour starts. The *presenting part* will be that portion of the fœtus which lies lowest and is felt on a vaginal examination when labour has been in progress for some time. Thus the fœtus may present either by the cephalic or by the podalic pole. We then speak of a *cephalic presentation* or a *podalic presentation*. It may sometimes also lie transversely, giving rise to a *shoulder presentation*. When it is a cephalic presentation different parts of the cephalic pole may lie lowest and the presenting part may therefore vary. Thus, depending upon the degree of flexion of the cephalic pole, we may have the vertex, brow, or face, as the presenting part.

The Lie of the Fœtus. This refers to the relation between the longitudinal axis of the fœtal ovoid and the longitudinal axis of the uterine ovoid. The longitudinal axis of the fœtus is the cephalo-podalic axis. When this axis corresponds to the longitudinal axis of the uterine ovoid the lie is said to be a *longitudinal lie*. When, how-

ever, the longitudinal axis of the fœtus is either oblique or transverse to that of the uterine ovoid the lie is said to be an *oblique* or *transverse lie*.

Position. By this term is understood the relation of the fœtus to the maternal pelvis. It is expressed in terms of the position of an

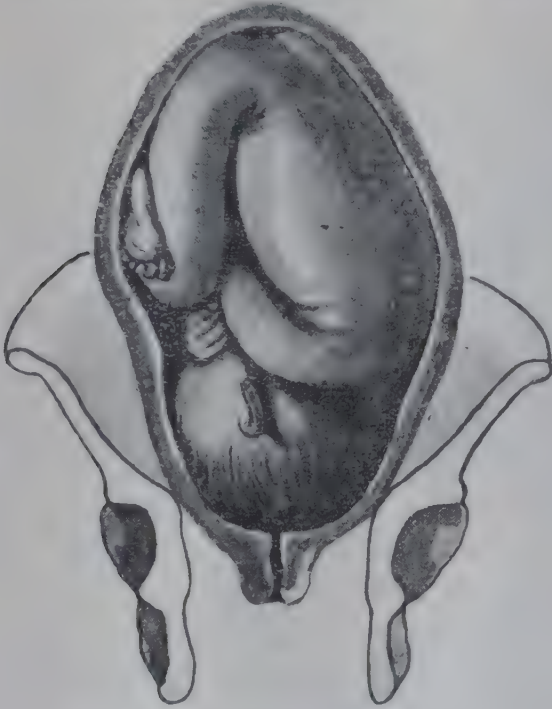


FIG. 22.—Vertex presentation—
first position L.O.A.

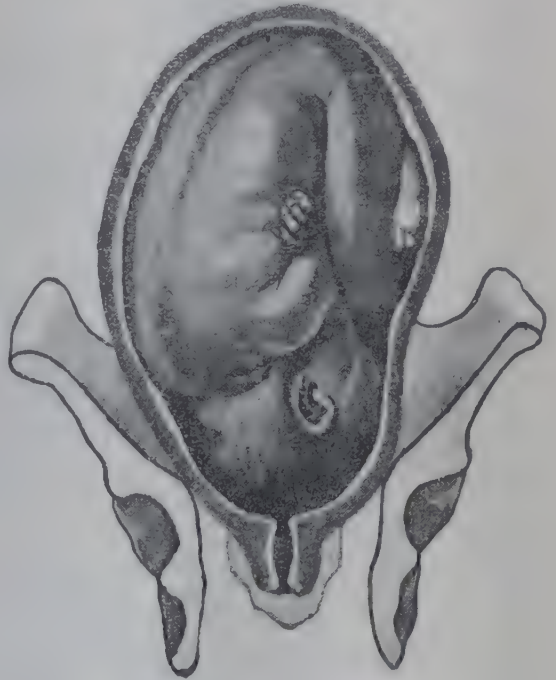


FIG. 23.—Vertex presentation—
second position R.O.A.



FIG. 24.—Vertex presentation—
third position R.O.P.



FIG. 25.—Vertex presentation—
fourth position L.O.P.

arbitrarily chosen part of the fœtus to the four quadrants of the maternal pelvis. In the different presentations a particular landmark, generally a bony landmark, is chosen and called the denominator;

and depending upon its position with reference to the four quadrants in the pelvic cavity the position of the fœtus *in utero* is determined. The four quadrants in any plane of the pelvis may be divided into the two right quadrants and the two left quadrants—these being the right anterior and right posterior, the left anterior and left posterior. The landmarks chosen as the denominators vary with the particular presenting part.

In cephalic presentations, when the *vertex* presents, the denominator is the *occiput*. When the *face* presents the denominator is the *chin* or *mentum*. When the *brow* presents the *frontal eminence* is the denominator. In *pelvic presentations* the denominator is the *sacrum*; and in *shoulder presentations* the denominator is the *acromion*.

Compound Presentation. Here more than one part of the fœtus will present.

The Fœtal Head. The passage of the fœtal head through the maternal pelvis is the most important factor in the delivery of the child. A careful study of the fœtal head is therefore essential to appreciate the part it plays in the mechanism of labour and the difficulties that may arise in the course of delivery (Fig. 26).

The fœtal skull consists of the vault, the base and the face. The vault of the skull is the portion above, which is subject to some degree of compression. The bones that go to form the vault of the skull, are the two frontal bones, the two parietal bones, the occipital bone, the two temporal bones and the wings of the sphenoid. These bones are not firmly united together by bony union. In between two bones is a thin piece of membrane which is spoken of as a *suture*. Where two or more sutures meet there is a wider expanse of membrane, and this is termed a *fontanelle*.

Thus we have :—

- (1) The *frontal suture*, situated between the two frontal bones.
- (2) The *sagittal suture*, situated between the two parietal bones.
- (3) The *coronal suture*, situated between the frontal and parietal bones.
- (4) The *lambdoidal suture*, situated between the posterior margins of the parietal bones and occipital bone.
- (5) The *temporal suture*, situated on either side between the inferior margin of the parietal bone and the upper margin of the temporal bone of the corresponding side.

When the cephalic pole of the fœtus presents, one or other of the sutures can be felt except the temporal suture. The direction of the sagittal suture in the maternal pelvis, and its relative position with reference to the oblique or transverse diameters of the pelvis are of importance in determining the nature and extent of abnormality, if any, in the position of the fœtal head.

There are four fontanelles which can be made out :—

(a) The *anterior fontanelle* or *bregma* is a lozenge-shaped space situated at the junction of the sagittal and coronal sutures. Four

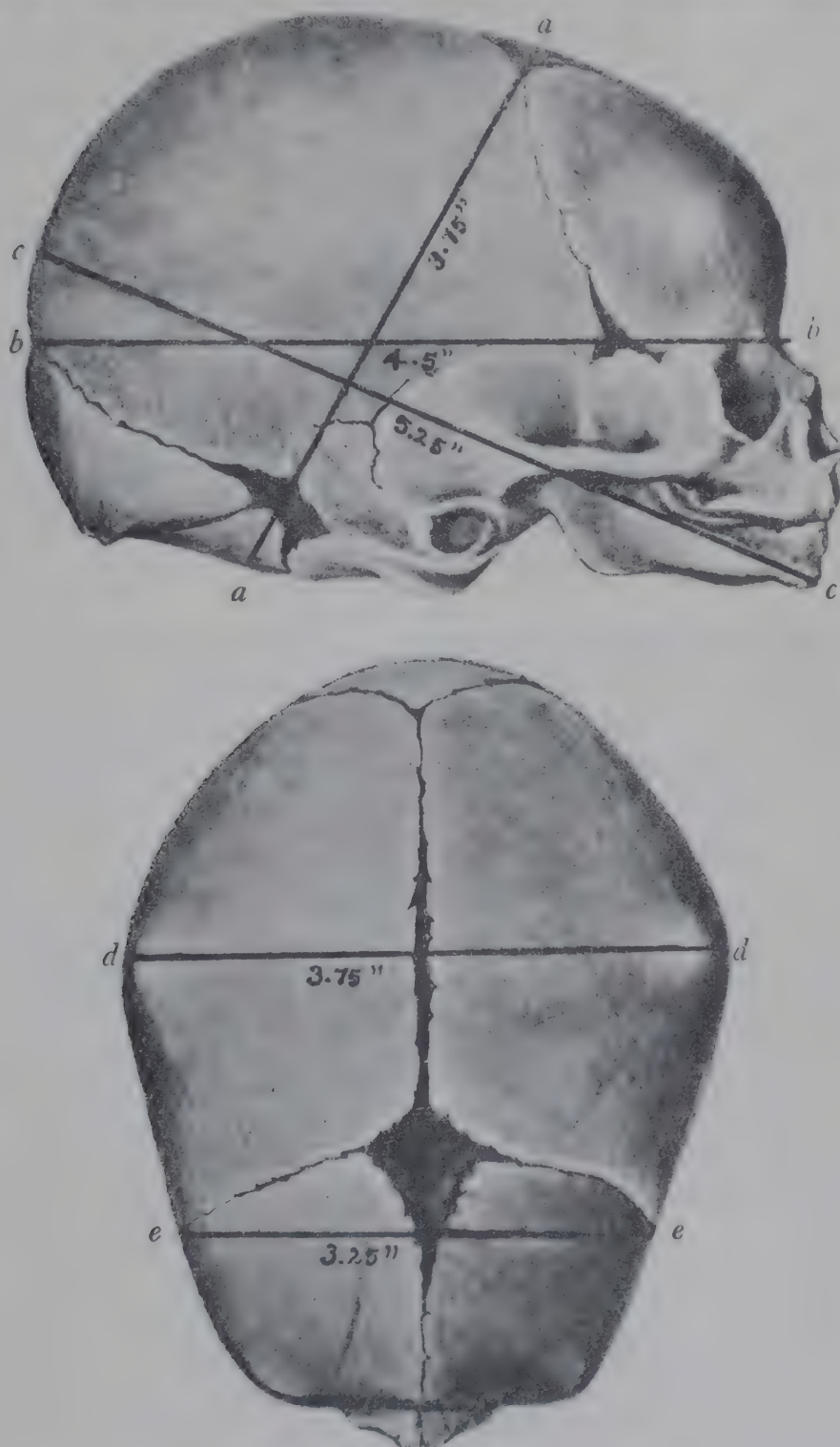


FIG. 26.—Diameters of the fœtal skull.

aa. Suboccipito-bregmatic. *cc.* Supra-occipito-mental. *ee.* Bitemporal.
bb. Occipito-frontal. *dd.* Biparietal.

bones can be felt at its edges—the two parietal bones on either side posteriorly and the two frontal bones in front. Three sutures are seen radiating from its centre—the sagittal, the coronal and the frontal.

(b) The *posterior fontanelle* is a smaller triangular area situated posteriorly at the junction of the sagittal and lambdoidal sutures. Three bones can be felt at the margins—the two parietal bones and the occipital bone, and its position with reference to the maternal pelvis forms an important landmark in differentiating the different positions of a vertex presentation.

(c) The *temporal* or *gasserian fontanelle* is situated at the junction of the lambdoidal and temporal sutures.

(d) Occasionally a lozenge-shaped space, smaller than the bregma, is found in the sagittal suture midway between the anterior and posterior fontanelle. This is sometimes spoken of as the *sagittal fontanelle*. It is not, however, a true fontanelle as it is not the result of the meeting of two or more sutures but is due to faulty ossification. It is of some clinical significance, as it may be mistaken for the anterior fontanelle. Such a mistake should not arise if the fontanelle be carefully palpated, and the sutures that should radiate and the bones that should meet are remembered.

Diameters of the Fœtal Skull. Certain diameters of the fœtal skull are important as they give an idea of the shape and size of the fœtal skull and an approximate measurement of the circumference. The diameters of the fœtal skull commonly taken into consideration are :—

(1) The *suboccipito-bregmatic*. This measures $3\frac{3}{4}$ ins. (9.4 cm.) and is the distance between the middle of the anterior fontanelle and a point just below the occipital protuberance. This is the diameter of engagement in a *vertex presentation*. The circumference of the fœtal head at this place measures 11 ins. (27.5 cm.).

(2) The *cervico-bregmatic* or *submento-bregmatic diameter* is the distance between the middle of the anterior fontanelle and a point that represents the junction of the chin and neck. It measures $3\frac{3}{4}$ ins. (9.4 cm.) and is the diameter of engagement in a *face presentation*.

(3) The *occipito-frontal diameter* is the distance between the root of the nose or glabella and the most prominent point on the occipital protuberance. It measures $4\frac{1}{2}$ ins. (11.25 cm.) and is the diameter which tries to engage when the head is in an attitude of deflexion in a vertex presentation. The circumference measures at this plane $13\frac{1}{2}$ ins. (34 cm.).

(4) The *vertico-mental* or *supra-occipito-mental* is the distance between the tip of the mentum or chin and the most distant point of the vertex. This is the longest diameter of the fœtal skull, measuring $5\frac{1}{4}$ ins. (13 cm.), and is the diameter of engagement in a *brow presentation*. The circumference around this diameter measures 15 ins. (37.5 cm.).

(5) The *biparietal diameter* is the maximum distance between the two parietal eminences. It measures $3\frac{1}{4}$ ins. (9.4 cm.).

(6) The *bitemporal diameter* is the maximum distance between the two temporal bones. This measures $3\frac{1}{4}$ ins. (8 cm.).

The foetal head is capable of moulding during labour because of the membranous union between the bones of the vault of the skull. Consequently, overriding of the bones occurs, the diameters become slightly shortened and the circumference diminished in size.

The base of the skull is made up of several bones united by firm bony union, and cannot therefore be diminished in size.

The face is likewise made of bones united firmly and is incapable of compression. The skull may be unduly ossified, when the foetus is over-mature. The sutures then are not so wide and the extent of moulding is considerably diminished. Greater difficulty is then experienced in the delivery of the foetal head, unless the maternal pelvis is proportionately roomy.

Frequency of the Presentations and Positions

It has been found that vertex presentations preponderate and occur in nearly 96 per cent of the cases, whereas pelvic presentations occur in 3 per cent, face 0.5 per cent and shoulder about 0.5 per cent.

Amongst the vertex presentations, the position that is most commonly adopted by the foetus is the left occipito-anterior, 70 per cent coming under this category. The group next in frequency is the right occipito-posterior position, occurring in over 25 percent of the cases. The rest of the cases are either left occipito-posterior or right occipito-anterior. Recent studies show that the shape of the pelvic inlet influences the mechanism of the engagement of the head at the brim and that occipito-transverse positions of the head are more common than originally thought to be.

It must, however, be realised that the position is likely to change during the course of labour; that ordinarily early in labour one may meet with an occipito-posterior position but as labour progresses the position changes to an occipito-transverse and finally to an occipito-anterior. It is on account of this factor that some confusion arises as to what exactly the position of the foetus was at the time the patient went into labour.

Causes which Influence the Frequency of a Cephalic Presentation. Several theories have been put forward to account for the preponderance of cephalic presentations, particularly vertex. There are two factors which are probably responsible: (1) the effect

of gravity and (2) the necessary adjustment between the fœtal ovoid and the uterine ovoid so as to allow for the most comfortable position for the growing fœtus.

Of the several reasons advanced to explain why the baby at term usually presents by the vertex, about the only tenable one seems to be the pyriform shape of the uterus. Although the fœtal head at term is slightly larger than the breech, the entire podalic pole of the fœtus—that is, the breech and its flexed extremities—is bulkier than the cephalic pole and more motile; the cephalic pole is represented by the head only, since the upper extremities are some distance removed and small and less protruding. Until about the thirty-second week the amniotic cavity is large in relation to fœtal mass, and there is no crowding of the fœtus by the uterine walls. At approximately that time, however, the ratio of amniotic contents to fœtal mass alters by relative diminution of amniotic fluid. As a result, the uterine walls are more closely apposed to the fœtal parts, and only then does the pyriform shape of the uterus exert its effect. The fœtus, if presenting by the breech, changes its polarity to make use of the roomier fundus for its bulkier and more motile podalic pole. The high incidence of breech presentation in hydrocephalic fœtuses is in accord with this theory, since there the cephalic pole is definitely larger than the podalic. On the other hand, the high frequency of breech presentations in anencephalic monsters is not against the theory, since such fœtuses are usually premature at delivery and hydramnios is the rule.

Among the causes of abnormal presentations are prematurity, hydramnios, uterine malformations, contracted pelvis, placenta prævia and tumours in the lower segment. These factors operate by altering the natural adjustment of the fœtal ovoid to the uterine cavity. Grand multiparity and lax abdominal wall are other common causes.

Methods of Obstetric Diagnosis. The methods of obstetric diagnosis are :—

- (1) Inspection.
- (2) Abdominal palpation.
- (3) Auscultation.
- (4) Vaginal examination or bimanual examination.
- (5) Rectal examination.
- (6) Radiography.

It is a time-honoured practice to resort to abdominal palpation and auscultation for the diagnosis of the presentation and position of the fœtus, and except in cases of difficulty it is not justifiable

to resort to a vaginal examination. Radiography helps to an easy recognition of the presentation and position, but it is to be hoped that these modern methods of easy diagnosis will not be used to the exclusion of the older methods, as the obstetrician must still rely on obstetric palpation for a complete diagnosis.

(1) *Inspection.* This is useful and must never be omitted. Inspection will reveal whether the uterine ovoid is longitudinal, oblique or transverse; whether there is overdistension as in cases of hydramnios or twins and whether any tumours are present.

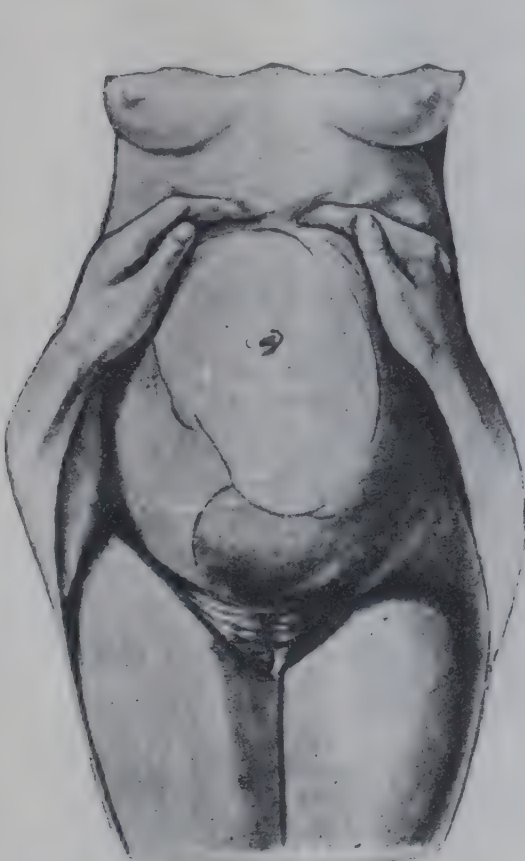


FIG. 27.—Methods of abdominal palpation—fundal grip.

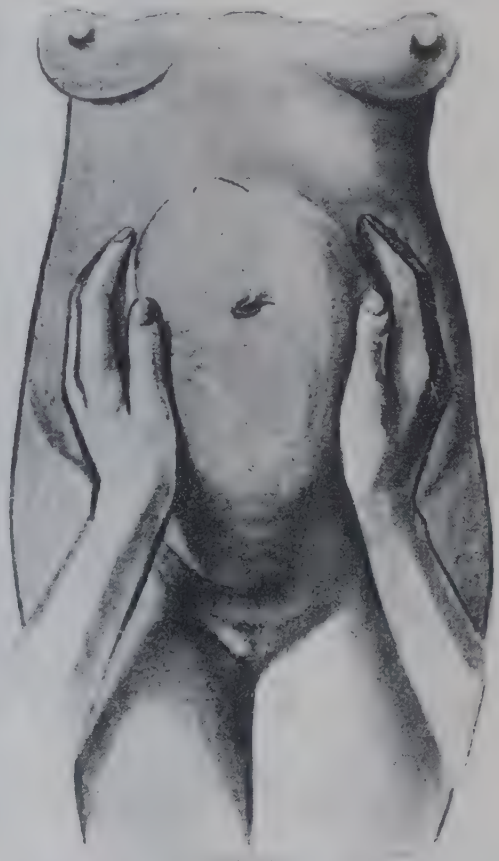


FIG. 28.—Methods of abdominal palpation—umbilical grip.

(2) *Abdominal Palpation.* This must be done systematically with the patient lying on her back with the thighs flexed. The height of the fundus should first be noted, as it gives an approximate idea as to the period of pregnancy. With the abdomen laid bare from the ensiform cartilage to a little below the symphysis pubis the obstetrician should proceed to palpate, facing the patient. The palms should be laid gently, one on either side of the abdomen taking care to see that they are not too cold so as to provoke contraction of the abdominal or uterine muscles and thus prevent effective palpation.

After outlining the contour of the uterus and noting the height of the fundus, the first manœuvre is to determine the part of the fœtus at the fundus. This is known as the *fundal grip*; by this grip

it will be possible to note whether the podalic or the cephalic pole is situated here, the head being generally harder, more round and more freely movable and ballotable.

The *second grip* or the *umbilical grip*. Having determined which pole of the fœtus is situated at the fundus, the examiner places the palmar aspects of the hands on either side of the umbilicus and gently palpates. On one side he will generally feel a hard, resistant surface,



FIG. 29.—Methods of abdominal palpation—Pawlik's or the first pelvic grip.

probably slightly curved, which is the back; on the other side a number of nodules will be felt which are the limbs. In some cases these nodules may be felt on both sides of the umbilicus. This indicates a posterior position, that is, one where the back is situated posteriorly and the limbs are anterior.

The *third and fourth grips* are very important, as they give many valuable data for obstetric diagnosis.

The *third grip* or the first pelvic grip is spoken of as *Pawlik's grip*. The examiner grasps the lower portion of the abdomen just above the symphysis pubis between the thumb and fingers of one hand, and by gently pressing the part enclosed between, finds out which part of the fœtus is presenting. If the cephalic pole is presenting, this will be felt as a hard, round mass, which, if not engaged in the pelvic brim, may ballot independently of the fœtal body. If the breech

is presenting, it will be found to be much larger in size, softer in feel and moving with the rest of the body. If the head is felt, a careful palpation may elicit the bony landmarks, namely, the occiput and the sinciput; and depending upon the relative positions of these, it is possible to determine whether in a cephalic pole it is the vertex, the brow, or face that is presenting. If the sinciput is at a higher level than the occiput, the vertex is presenting; if the sinciput and the occiput are on the same level, a deflexed vertex is presenting; if the sinciput, on the other hand, is on a lower level than the occiput, the face is presenting.



FIG. 30.—Methods of abdominal palpation—second pelvic grip.

The *fourth grip* or the *second pelvic grip*. This is very useful, not only to confirm the findings of Pawlik's grip but also to determine other points of obstetric importance. In this grip the examiner faces the patient's feet, and with the tips of the fingers of each hand, makes deep pressure in the direction of the pelvic brim. The thighs should be semi-flexed, to relax the abdominal muscles and the fingers on either side dipped deep down, with a view to get more intimately in touch with the presenting part of the fœtus. On a careful palpation, if the head is presenting, the fingers of one hand will feel the occiput and those of the other hand the sinciput. The relative positions of these two bony landmarks in the different presentations have already been referred to.

This grip enables one to recognise whether the presenting part has descended into the pelvis, and if so, how far; also to make out whether there is any disproportion between the presenting part and the brim of the pelvis.

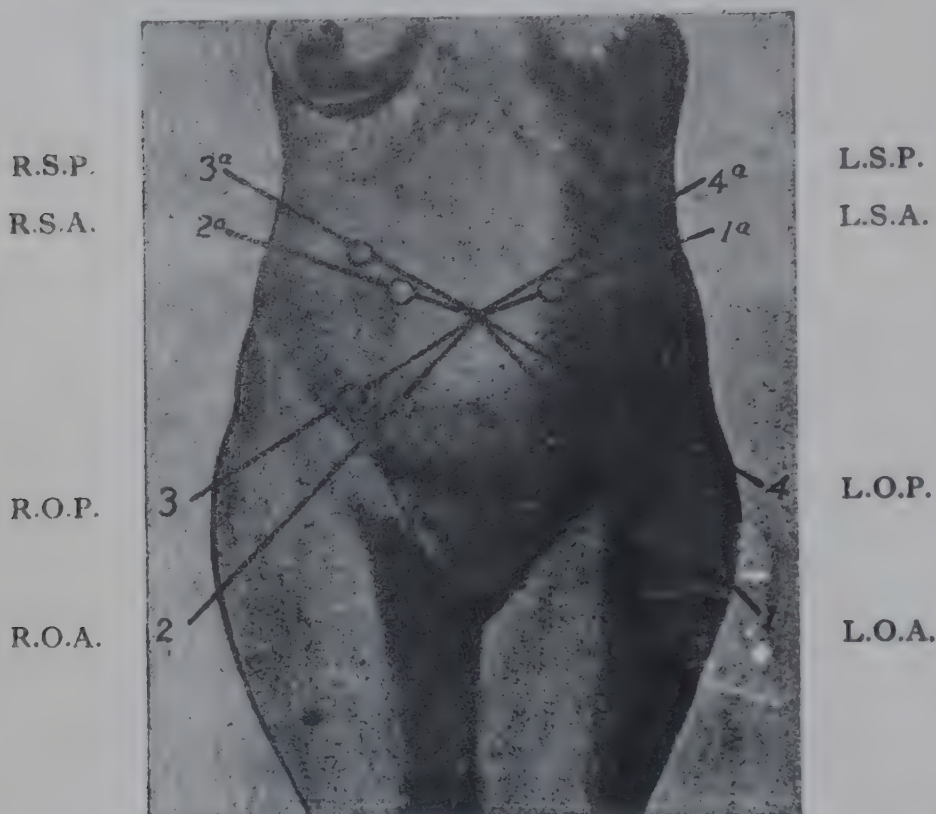


FIG. 31.—Position of foetal heart in the several positions of vertex and breech presentations.

It is so valuable for purposes of obstetric diagnosis that we have for some time given up the practice of palpating in the order above mentioned. We start with the second pelvic grip first, our object being to prevent stimulation of the abdominal muscles, which occasionally happens during the routine palpatory method suggested above. If the abdominal muscles are fairly lax, the second pelvic grip will help us to recognise in the majority of instances, along with Pawlik's grip if necessary, the exact presentation, position, disproportion if any, and progress in labour. Palpation of the anterior shoulder may be helpful in the diagnosis of foetal position in the pelvis and also in the follow-up of the descent of the head and its rotation during labour.

(3) *Auscultation.* This helps us to diagnose whether the foetus is alive, and by a careful recognition of the point of maximum intensity of the foetal heart sounds, to locate also the position of the foetus. Many other subsidiary sounds that are heard by auscultation have been referred to elsewhere. As a general rule the point of maximum intensity of the foetal heart sound is below the

umbilicus in all cephalic presentations ; above the umbilicus in podalic presentations ; and almost on a level with the umbilicus in oblique or transverse lies. The position also varies with reference to the position of the back of the fœtus. In cases where the back is to left or right, the fœtal heart sounds are heard on the same side, nearer the middle line in anterior position, and farther away in posterior position.

(4) *Vaginal examination.* Vaginal examination in the early weeks of pregnancy helps : (1) to establish the diagnosis of pregnancy ; (2) to decide whether the pregnancy is uterine or extra-uterine ; (3) to ascertain whether there are any tumours or other abnormalities in the genital tract complicating pregnancy.

In the later weeks and particularly near term, it helps in the diagnosis of the presentation and position of the fœtus and also in assessing the pelvis. The risk of infection by a careless vaginal examination is always present ; hence the examination should be done with all antiseptic precautions. The safety afforded by antibiotics has resulted in unnecessary and frequent vaginal examinations. This is a tendency which must be rigidly curbed.

(5) *Rectal examination.* Great emphasis was placed on rectal examination as a substitute for vaginal, prior to the advent of antibiotics. At present we seldom resort to it. Under modern conditions, a carefully conducted vaginal examination is not in any way hazardous to the patient.

(6) *Radiography.* There is no doubt that radiography is a useful tool in obstetrics and till a few years ago, it was widely adopted. Realization of the hazards of radiation has led to a restriction of its use in obstetrics and it should be avoided particularly in the early weeks of pregnancy. The place of radiology in obstetrics is discussed later.

ANTENATAL CARE

IN recent years there has been a marked reduction in maternal and perinatal mortality and morbidity. Apart from other factors, it is proper antenatal care of the pregnant woman which has brought about the remarkable results. The main object of antenatal care is to ensure that the pregnant mother maintains good health throughout pregnancy and is safely delivered of a healthy child. If these objectives are to be achieved it is essential that the pregnant woman be examined by a doctor as early in pregnancy as possible and thereafter at regular stipulated intervals—usually once a month till the 28th week, once a fortnight till the 34th week and from then on once a week till term. Certain examinations and investigations to be mentioned later have to be carried out at these visits. The advice given to a pregnant woman is usually based on the observations at these examinations. These include general, personal and obstetric history, medical and obstetric examination and certain laboratory tests.

General history. The name, age, parity and date of the last menstrual period and estimated date of delivery are first recorded. Inquiries should then be made regarding the family history with special reference to diseases like tuberculosis, hypertension, hereditary and such other diseases which may have an effect on childbearing. The personal history of the patient with special reference to diseases in childhood such as rickets, acute rheumatic fever, renal disease and such other diseases which may affect childbearing should then be reviewed.

Obstetric history. In a multigravida the history of previous pregnancies and labour should be recorded in detail. The enquiry should be particularly directed to any difficulties experienced in previous pregnancies and labours such as abortions, premature births, toxæmia, antepartum hæmorrhage, prolonged labour, stillbirths and neonatal death, nature of delivery—spontaneous or operative—postpartum hæmorrhage and the nature of the puerperium. In cases where the delivery has been assisted, the nature of the difficulty and the mode of interference should be ascertained.

History of present pregnancy. The date of the last menstrual period if known, as also the estimated date of confinement would have been recorded along with the general history. Any complaints regarding general health during the present pregnancy should be

looked into as also any complication in pregnancy—vomiting, nausea, swelling of the feet and face, constipation, sleeplessness are some of the common complaints met with which may require attention.

The general medical examination. Apart from complete examination of the respiratory, cardiovascular, alimentary and other systems, this should also include noting the stature, height and weight of the patient and taking the blood pressure. Generally speaking short women have usually a smaller pelvis as compared to taller ones. But this does not always mean that labour will be difficult as often in such persons the babies may also be smaller. Taking the weight of the mother at each visit is one of the most essential parts of antenatal care. Ordinarily the total increase in weight is between 5 and 8 kg. during the whole course of pregnancy. But many factors influence the weight gain. Socio-economic factors play a prominent role and it is not unusual to find that among the poor class the average weight gain may be as low as 3-4 kg. However, more important than the total weight gain is the rate at which the weight is put on. In a normal pregnancy it is about $\frac{1}{2}$ kg. a week from the second trimester onwards. Any sudden increase of over $\frac{1}{2}$ to 1 kg. should be viewed with suspicion and is usually the result of œdema pointing to a tendency for the 'development of pre-eclamptic toxæmia.

Blood Pressure. The systolic and diastolic blood pressures should be recorded at each visit without fail. The estimation of the blood pressure should be made after the patient has been at rest for a while. Normally the systolic pressure ranges from 100-120 mm. of Hg. and the diastolic from 70-80 mm. of Hg. Systolic pressure at or over 140 mm. of Hg. and diastolic of 90 mm. of Hg. and over must be viewed with suspicion as early evidence of hypertension or commencing pre-eclamptic toxæmia. If the systolic pressure rises to near 160 mm. of Hg. or more and the diastolic to 100 mm. of Hg. admission to hospital is obligatory.

In addition to these general observations any foci of infection—like the teeth—should be looked for. The nipples and the breast require special attention.

Obstetric Examination

This consists in noting the following :—

The Height of the Uterus. This varies with the period of pregnancy and may be altered by any complications. The height of the uterus is not always a safe guide to the period of pregnancy,

as in cases of hydramnios, concealed accidental hæmorrhage, twins, monsters and tumours of the uterus complicating pregnancy, the uterus may be much bigger than normal; on the other hand, it may be much smaller than normal in cases of intra-uterine death of the fœtus and oligo-hydramnios. In the earlier weeks, conditions like vesicular mole may increase the size of the uterus, while in ectopic gestation and in cases of missed abortion the uterus may be much smaller.

Abdominal Palpation and Auscultation. This must be done as a matter of routine and the observations recorded. The presentation and position of the fœtus and its state in the last trimester should be ascertained by palpation and fœtal heart auscultation. Malpresentations are frequent prior to 32 weeks and most of them undergo spontaneous correction by 34-36 weeks. If correction is undertaken prior to 34 weeks recurrence occurs frequently. It is therefore not essential to correct malpresentations prior to 34 weeks. After this period spontaneous rectification is less frequent. Hence it is advisable to attempt correction after the 34th week, when chances of recurrence also will be less. Whenever malpresentations are encountered it is necessary to identify the causative factor.

Pelvimetry. For a long time external pelvimetry held a very important place in methods of obstetric examination, as it helped the obstetricians to identify contractions of the pelvis. The common measurements that are taken at the brim are :—

- (1) intercrystal,
- (2) interspinous,
- (3) external conjugate ;

and at the outlet, the transverse, antero-posterior and posterior-sagittal diameters. The importance of these measurements is discussed in the chapter on Contracted Pelvis.

Internal Pelvimetry. This is more accurate but more difficult and uncomfortable to the patient. Except for the measurement of the diagonal conjugate, internal pelvimetry is not employed in routine antenatal examination.

Radiopelvimetry. This is a very accurate method of determining the various diameters of the pelvis at the brim, cavity and outlet. For over a decade, it had established itself as a routine compulsory method of examination in all primigravidæ and in multiparæ with bad obstetric history. Recent understanding of radiation hazards in pregnancy has curbed its use in obstetrics. At present, the tendency is to use radiopelvimetry only in cases wherein dystocia is anticipated and

not to use it as a routine. Further details are given in the chapter on Contracted Pelvis.

Cephalometry. A knowledge of the size of the foetal head can be obtained by measuring the biparietal diameter of the foetal skull. This can be done by cephalometry using radiological techniques. Ultra sound techniques are now being employed with greater safety for measuring the foetal skull diameters.

Vaginal examination. In the first trimester it is advisable as a routine to make a vaginal examination. The aim of the examination is (1) to confirm the diagnosis of pregnancy (2) to decide whether the pregnancy is uterine or extra-uterine (3) to determine the presence or absence of any adnexal pathology and congenital abnormalities of the genital tract itself. In all primigravidæ after the 38th week of pregnancy as a routine a vaginal examination must be done to note the nature of the cervix, the presentation of the foetus, to assess the pelvis, its capacity at all levels and to estimate the degree of cephalopelvic disproportion, if any, usually by the Munro-Kerr-Müller method.

Laboratory Tests. The most important laboratory tests carried out are the urine examination, serologic test for syphilis, estimation of the hæmoglobin and the Rh. and major blood group determination.

The urine should be examined for albumin and sugar at each visit. The serological test employed for syphilis is usually the V.D.R.L. test. From the point of view of the foetus it is of the utmost importance that this test be done as early in pregnancy as possible.

Anæmia being the commonest and a grave complication in pregnancy, it is essential that the hæmoglobin be estimated at every visit. On an average the hæmoglobin level of the majority of pregnant women in India is between 10.5 gm.% and 11.5 gm.%. Should the Hb. fall below 10 gm.% the patient should be further investigated. This is discussed under 'Anæmia in pregnancy'. The dangers of Rh. and ABO iso-immunisation are now well recognised. It is therefore essential that all pregnant mothers should have not only the major blood group determined but also the Rh. type.

If all these different observations are recorded at the antenatal clinic on the first and subsequent occasions much useful information will be available to enable the obstetrician to come to some conclusions regarding the probable nature of the delivery. It is important to emphasise the fact that the pregnant woman must attend the clinic at regular intervals mentioned already.

Advice to the Expectant Mother

Impress upon her the need for regular attendance at the clinic and assure her that if a few simple physiological laws are followed, the course of pregnancy will be smooth and labour will be safe. Unnecessary alarm should not be raised even in the presence of minor ailments, as one of the most essential factors for success is the right mental attitude of the expectant mother. The obstetrician should emphasise in simple language certain signs or symptoms, the appearance of which must necessitate an immediate consultation. He can assure the pregnant woman that if proper steps are taken in time there need be no unnecessary anxiety.

Diet. The diet of a pregnant woman should preferably be light and nutritious and should besides supplying the chief proximate principles, provide the necessary vitamins and the calorie requirements of the mother. A daily intake of about 2,500 to 2,800 calories meets the total energy needs of the average pregnant woman. A low calorie diet may be necessary for the very obese pregnant woman. In such a case the caloric value of the diet only should be limited without reducing the quantity of proteins, minerals and vitamins. This requires special dietary calculations.

Salt is best restricted throughout pregnancy. A mixed diet containing more proteins and vegetables and less of fatty and greasy food is more suited to a pregnant woman. If possible, two pints of milk a day should be taken. Green leafy vegetables help to provide some extra iron to the mother. Fresh fruits and vegetables are advocated. Meat, fish, eggs, bread, rice, curds, all form part of the good diet. Malnutrition in pregnancy is a big problem in tropical countries.

Any attempt to restrict the intake of food carries with it the serious risk of inducing nutritional deficiencies in both mother and the child. There is a much higher incidence of miscarriage, still births, premature births and minor complications in women with poor diet than in others. Over-eating also must be avoided.

The daily dietary requirements of a normal pregnant woman doing light housework during the second half of pregnancy is as follows :

Calories	.	.	2,400-2,800.	Vitamin A	6,000 I-u.
Protein	.	.	80-100 gm.	„ B-1	500-1,000 I-u.
Fat	.	.	80-100 gm.	„ B-2	3-3.5 mg.
Carbohydrates	.	.	350-400 gm.	„ C	50-57 mg.
Calcium	.	.	1.5 gm.	„ D	500-1,000 I-u.
Iron	.	.	0.020 gm.		
Iodine	.	.	as iodised salt		

Because of the very large incidence of severe anæmia in pregnancy due both to poor diet and demands of the fœtus, it is advisable to give to all pregnant women throughout their pregnancy, a tablet containing 200 mgm. iron in the form of ferrous sulphate or fumarate and 0.5 mgm. of folic acid. Such medication will help to reduce significantly the incidence of anæmia in pregnancy.

Care of the Breasts. This is very important and should be attended to in the last weeks of pregnancy. When the breasts begin to enlarge, the clothing should be such that it does not cause undue pressure. If the breasts are big and heavy, some form of support should be provided by a properly fitting brassière. In the later weeks, the nipples should be washed daily with soap and water and drawn out. Any cracks should be attended to.

Other instructions :

Moderate exercise is beneficial in pregnancy. Hard and tiring work is best avoided. Clothing worn should be light and comfortable. Daily bath, restriction of sexual intercourse and its avoidance in the first and last few weeks of pregnancy are beneficial. Bowels must be kept regular. Constipation should be avoided by regulation of diet and if necessary by taking one or other of the mineral oils. Purgatives are best avoided. The prospective mother should maintain an equable temperament, and should avoid all mental excitement. Reading books on mothercraft is helpful in maintaining the requisite mental environment necessary to regard pregnancy and labour as a physiological process.

Especially in the developing areas of the world where infectious diseases like small-pox, cholera, typhoid, are endemic and often occurs in epidemic forms it is essential to immunise all pregnant women against these diseases by vaccination if they have not already been immunised. Neonatal tetanus is prevalent in these areas and plays a major role in perinatal mortality. It can be prevented by immunising the pregnant women by tetanus toxoid injections. It is advisable to administer the toxoid in two or three divided doses in the three trimesters of pregnancy.

General Advice. The patient should be warned of certain symptoms which, when present, should immediately make her consult her obstetrician. Bleeding from whatever cause, reduction in the quantity of urine, any swelling of the lower extremities, continuous headache, pain in the epigastrium, dimness of vision, sleeplessness, cramps in the legs, painful contractions of the uterus from whatever cause, rupture of the bag of membranes irrespective of the period of pregnancy, should all make her report to the obstetrician

for suitable advice. If everything is normal, the pregnant woman should attend the antenatal clinic at periodic intervals as mentioned earlier in this chapter.

The pregnant mother should be told when she may expect labour to begin, and all arrangements should be made so that at the onset of labour she will have the assistance of a well-qualified midwife, and be in possession of the necessary outfit and armamentarium required for a delivery.

One word of caution must be given. Antenatal care is not an end in itself, but is a means to an end, namely, a safe delivery. Antenatal care will go far to ensure this ; but something more is essential, namely, efficient intranatal and postpartum care. Nothing that can be done by antenatal care will be of any avail if proper obstetric help is not available during labour. While antenatal care can be given efficiently by a large number of practitioners, cases do occur where it is desirable, because of the possible difficulty at labour, that the expectant mother should be referred to a consultant antenatal clinic, manned by specialists. Where there are adequate antenatal supervision, skilled midwifery, proper attention to details at the bedside, vigilant postnatal care and hospitalisation where necessary, maternal mortality could be reduced to a quarter of the national average. It is also well to realise the limitations of antenatal care ; some abnormal conditions cannot be prevented by any efficient method and in other cases complications may arise without previous warning. In the majority of cases antenatal care will certainly help the patient to go through pregnancy safely and to face labour with equanimity.

SECTION III

PHYSIOLOGY OF LABOUR

CHAPTER X

CAUSATION AND STAGES OF LABOUR

Definition. Labour is the process by which the products of conception, when they have reached full-term, or are nearing it, are separated from the uterus and expelled through the genital passages.

Labour may end spontaneously or may require external aid to complete it. When a full-term foetus presenting by the vertex is expelled by natural efforts unaided within a period of twenty-four hours, the term *normal* or *natural labour* is used to designate the condition. Labour is termed premature if it sets in before 37 weeks. Spontaneous expulsion of the products of conception before the period of viability of the foetus is termed *abortion* or *miscarriage*.

Uterine Action. One of the most intriguing problems in obstetrics is the mechanics of uterine action and the cause of onset of labour at term. The uterus is a hollow muscular organ which exhibits involuntary contractions in the non-pregnant as well as in the pregnant condition. These contractions are under vascular, hormonal and nervous control. To understand the physiology of normal labour as well as to appreciate its departure from the normal, it is necessary to study the uterine musculature in pregnancy, its activity and the mode of control. It is not proposed to go into details here but an attempt is made to present as concisely as possible the modern concept of uterine activity.

Architecture of the Myometrium. The complex arrangement of the interlacing muscular components of the wall of the uterus has not been made out satisfactorily. It is generally felt that the uterine musculature is arranged in three rather indefinite layers—a thin external, a thin internal and a thick middle stratum. The external stratum is made up of a vascular layer, a secondary stratum continuous with the uterine ligaments and a longitudinal layer. The vascular layer is adjacent to the thick middle stratum and contains many blood vessels interspersed between loosely interwoven muscle bundles and connective tissue which has undergone the characteristic pregnancy changes. The secondary stratum is continuous with the ligaments of the uterus and covers the vascular layer. Its fibres become attached to the deeper muscle stratum after penetrating the vascular layer. The longitudinal layer lies beneath the serosa and consist of delicate longitudinal fasciculi which are continuous with the longitudinal layer of the tubes.

The middle stratum is the most important. In the interstices of the muscular network, blood vessels pass to the endometrium from the external vascular zone. When the uterus contracts and retracts after the fœtus and placenta are expelled at the end of labour, these vessels are compressed and twisted and kinked to shut off the blood supply to the placental lake. The middle stratum therefore furnishes not only the greater part of the force that is derived from a uterine contraction but it also effectively constricts the vessels which supply the open sinuses in the placental site, thus preventing postpartum hæmorrhage after delivery.

Cervix. The cervix undergoes changes similar to those described in connection with the body of the uterus. There are marked alterations in the mucosa, a great increase in vascularity and slight hypertrophy and hyperplasia of the muscle and connective tissue. As a result of these changes, the cervix becomes progressively softened, the softening being marked in 6 to 8 weeks.

Methods of Study of Uterine Action

Various mechanical devices have been used to study the activity of the gravid uterus. External tokography, recording by intra-uterine balloons, and electrical methods have been used. Recording of uterine contractions in various parts of the uterus has been made by the tokodynamometer which has helped to understand the part played by the various segments of the uterus in the expulsion of the fœtus.

The main aim of the uterus in labour is to expel its contents. It is necessary for the upper segment and the lower part of the uterus to

behave differently to achieve this end. Thus when the upper segment contracts and retracts, the lower segment including the cervix dilates to allow the passage of the foetus. To this intrinsic property the term 'polarity' is applied. This fundamental difference in the nature of the contractions has been indisputably demonstrated by tokodynamometer studies when a diminishing gradient of the strength of uterine contraction is seen, starting from the fundus through the body to the lower uterine segment. It has been taught for a long time that the lower uterine segment is completely passive in labour and is not capable of contraction. Recent studies tend to show that it is capable of contraction but to a very limited degree. For labour to progress, the contractions of the fundus must be strong and sustained, with less strong simultaneous contractions of the middle zone and relative inactivity of the lower parts. According to Reynolds, there is a 'gradient of diminishing physiological activity'. These contractions must also be co-ordinated and simultaneous.

In pregnancy from the earliest weeks, the uterus shows signs of intermittent contractions (Braxton Hick's sign). These contractions are irregular in time and force and do not show any co-ordination or diminishing gradient. As pregnancy advances, there is a gradual increase in muscle tone and sensitivity. The spontaneous contractions become more frequent and regular. Occasionally they become painful until ultimately at term they convert themselves into the labour contractions. The characteristics of the labour contractions are :—

- (1) They are accompanied by retraction.
- (2) There is fundal dominance.
- (3) There is a diminishing gradient of activity from fundus through body to the lower uterine segment.

It is reckoned that the expulsive pressure of an average uterine contraction amounts to about 7 kg. To this the secondary expulsive pressure of the abdominal wall must be added which is about 7 kg. thus making a total expulsive force of 14 kg. Occasionally the expulsive force of uterine contraction stimulated by pituitrin may reach 14 kg. or more so that the foetus may in exceptional cases receive a total thrust of nearly 23 kg. In forceps delivery the average force exerted by traction is said to be about 16 kg.

The Control of Uterine Action. The uterine action is under hormonal and nervous control. Provided it is supplied by the necessary nutritive agents and it has been under oestrogen influence, the uterus will go on contracting even when it is isolated from its nervous connections. Some believe in the presence of an intrinsic nerve plexus which was formerly thought to co-ordinate the actions of the upper and lower segments. The uterus is supplied by both sympa-

thetic and parasympathetic nerves. The present concept of the innervation of the uterus points to a rich supply of sympathetic adrenergic nerves which travel via the superior and inferior hypogastric plexus. The motor fibres of these nerves appear largely to be inhibitory, for their stimulation produces contractions of the circular muscle fibres and the lower segment. The uterus receives supplies from the parasympathetic nerves also—though recently some doubt has been cast. These cholinergic fibres travel from the 2nd, 3rd and 4th sacral nerve roots through the inferior hypogastric plexus to reach the uterus. Stimulation of these nerves is said to cause contractions of the detrusor muscles of the upper segment. According to this concept the parasympathetics help in emptying the uterus while the sympathetics prevent it. Good uterine action depends on a normal balance between the two. Sensory impulses from the uterus probably travel by both sympathetics and parasympathetics. The latter carry mainly sensory (pain) impulses from the cervix and the lower segment giving rise to pain in the back. The presacral nerves and the nerves accompanying the ovarian vessels carry the impulses from the upper segment and give rise to referred pain in the lower abdomen and iliac fossæ corresponding to segments of T₁₀, T₁₁ and T₁₂ which probably represent the level at which the pain-conducting fibres reach the spinal cord.

The Hormonal Control. The hormones which are intimately concerned with uterine activity are œstrogen, progesterone and pituitrin. During pregnancy there is a considerable increase in the amount of œstrogen and progesterone circulating in the system. Oestrogens, in addition to increasing the vascularity and producing growth of the uterus, induce uterine contractions and sensitize uterine musculature to the action of pituitrin. Progesterone has however a more quiescent effect. It also produces uterine contractions but these are usually of a greater amplitude but of lesser frequency and are not effective. As pregnancy approaches term, the increasing œstrogen renders the uterus more and more sensitive to the oxytocic hormone, pituitrin. The efficacy of a uterus in labour is thus dependent upon a proper balance of the hormones, the sympathetic and parasympathetic supply. Placenta and uterus contain large amounts of acetyl choline at the time of labour. One of the effects of œstrogen is to liberate acetyl choline which is a stimulant of the parasympathetics. There are some who consider the nervous influence as completely inhibitory. This is not quite correct, for contractions are abolished completely by epidural anæsthesia extending up to T₅ and T₆ and also in some cases of disseminated sclerosis.

The adrenals also are said to play a part in the uterine contractions. A probably inhibitory effect is now attributed to adrenaline which

may cause a temporary cessation of labour pain. It will be recalled that emotion or fright adversely affects a woman in labour which may be due to the flooding of the system with adrenaline as a result of the sympathetic stimulation by emotions.

Causation of labour. In spite of a vast amount of research so far it has not been possible to identify the exact cause of onset of labour at term in normal pregnancy. Some of the important factors which have a bearing on this problem are briefly discussed.

The hormones. During pregnancy there exists a nice balance between the uterine stimulating action of œstrogen and uterine relaxing effect of progesterone. Towards term there is a drop in the progesterone level in the blood which upsets this balance in favour of the stimulating action of œstrogen. There is controversy on this point.

The blood levels of oxytocin and oxytocic substances increase during labour which suggests that this hormone is important for the completion of labour and prevention of postpartum hæmorrhage. The present evidence that blood levels of oxytocin rise during labour only in normal patients and that those with Diabetes Insipidus are frequently unable to complete delivery indicates that while the role of oxytocin in the initiation of labour has not yet been established, it plays an important role in regulating activity during labour.

Uterine distension. Any hollow viscus whether uterus, bladder or bowel tends to contract and empty itself when distended to a certain extent. Reynolds has shown that as pregnancy nears term uterine growth slackens whereas the rate of fœtal growth increases. This results in rapid increase in intrauterine pressure. The resultant tension enforced on uterine muscle fibres may itself initiate labour.

Mechanical irritation. The stretching of the lower uterine segment by the fœtal head and the pressure exerted by it on the paracervical nerve ganglia are probably important factors in the onset of labour. This theory finds its chief support in the efficacy of artificial rupture of membranes in induction of labour at term.

Available evidence suggests that the factors concerned in the maintenance of pregnancy are myometrial growth and increased myometrial compliance to accommodate the growing fœtus, increased placental progesterone and autonomic change from neural to hormonal influence. As opposed to these, factors which bring about termination

of pregnancy are increasing uterine volume, decrease of placental progesterone and oxytocic release.

Stages of Labour. Three stages are generally recognised in the process of labour.

To these may be added what may be called the preparatory stage of labour, which may begin about two to three weeks before the onset of labour in a primigravida and a few days before in a multigravida. The phenomena of the preparatory stage consist of:—

(1) The falling forward of the uterus with the head sinking into the pelvis, resulting in the so-called 'lightening', due to the relief of pressure exerted by the gravid uterus upon the diaphragm and therefore on the lungs and heart.

(2) The gradual shortening of the cervical canal—a process that commences some days before the actual onset of labour in some instances.

(3) False or spurious labour pains which occur more frequently in primigravidæ than in multiparæ. False pains are often caused by a temporary indigestion or by a loaded rectum. They are relieved either by a laxative or an enema. They are distinguished from true labour pains by their temporary character, irregularity and by the fact that they are felt generally over the abdomen, instead of in the lumbosacral region or just above the pubis. They do not progress, they are not associated with any contractions of the uterus and do not cause any dilatation of the cervical canal.

When true labour pains set in, the three stages referred to already will be noted. They are:—

(1) The first stage—or the stage of dilatation.

(2) The second stage—or the stage of expulsion.

(3) The third stage—or the stage of placental delivery and uterine contraction and retraction.

First Stage

This extends from the onset of true labour pains to the complete dilatation of the os when rupture of the bag of membranes usually occurs. The duration of this stage is variable. On an average it extends in a primigravida to sixteen hours, while in a multigravida the average is from six to eight hours.

The phenomena during this stage of labour are:—

(1) Uterine contractions, or true labour pains.

(2) Muco-sanguineous discharge, or the 'show'.

- (3) Dilatation of the cervical canal, so that both the internal and the external ora become completely dilated.
- (4) In normal cases fixation of the head at the brim of the pelvis and its progressive descent.
- (5) Rupture of the membranes.

Uterine Contractions, or true labour pains, occur at intervals of half an hour at the commencement of the first stage, but gradually they come on more frequently, till towards the end of the first stage

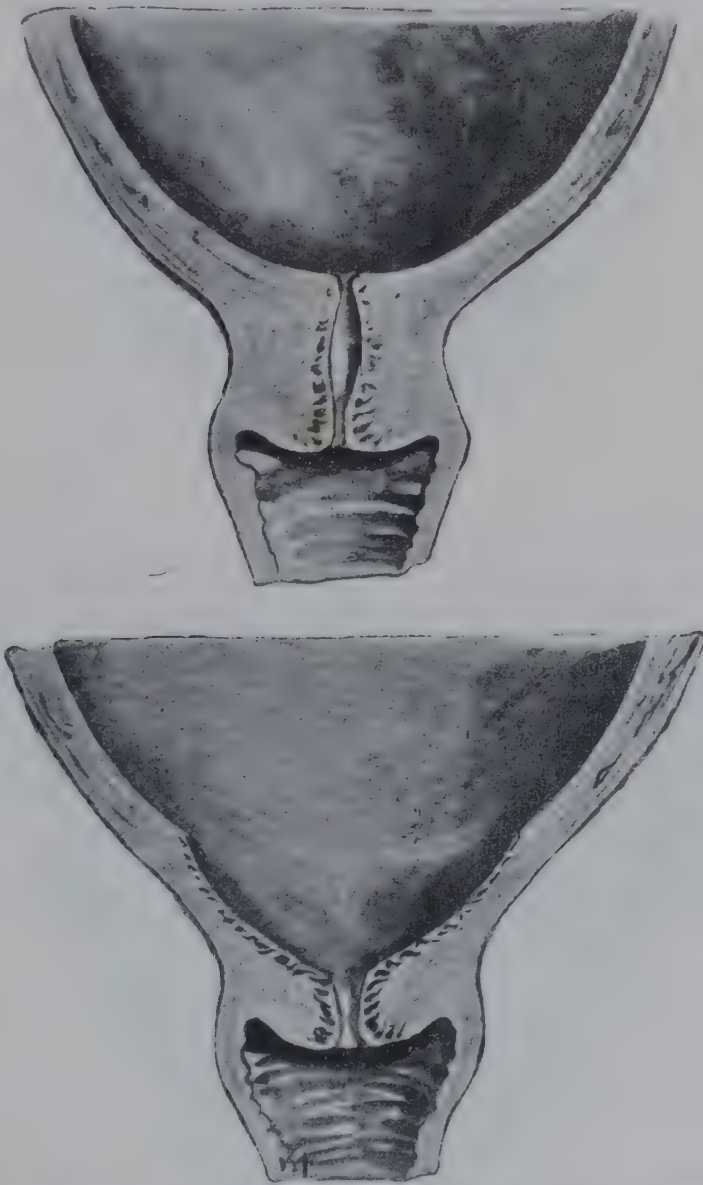


FIG. 32.—Stages of dilatation of the cervical canal in a primigravida.

they may occur every few minutes. The duration of each contraction lasts about 45 seconds to one minute. Each contraction gradually increases in intensity reaching an acme and then diminishes in intensity. In normal labour, the intra-uterine pressure is usually about 35 mms. of Hg.; occasionally it may be as high as 50 mms. of Hg. At first the pains are felt in the region of the sacrum, but later they radiate to

the lower abdomen, and sometimes down the legs. In some cases they may be associated with a feeling of nausea or actual vomiting, and urine may be passed frequently. The cervix becomes more soft and patulous, till at the end of this stage its rim becomes continuous with the walls of the vagina.

Muco-sanguineous Discharge is from both the cervix and the vagina. The dilatation of the lower uterine segment and of the cervix that occurs in the first stage promotes separation of the membranes from the wall of the uterus, giving rise to a slight hæmorrhage, while

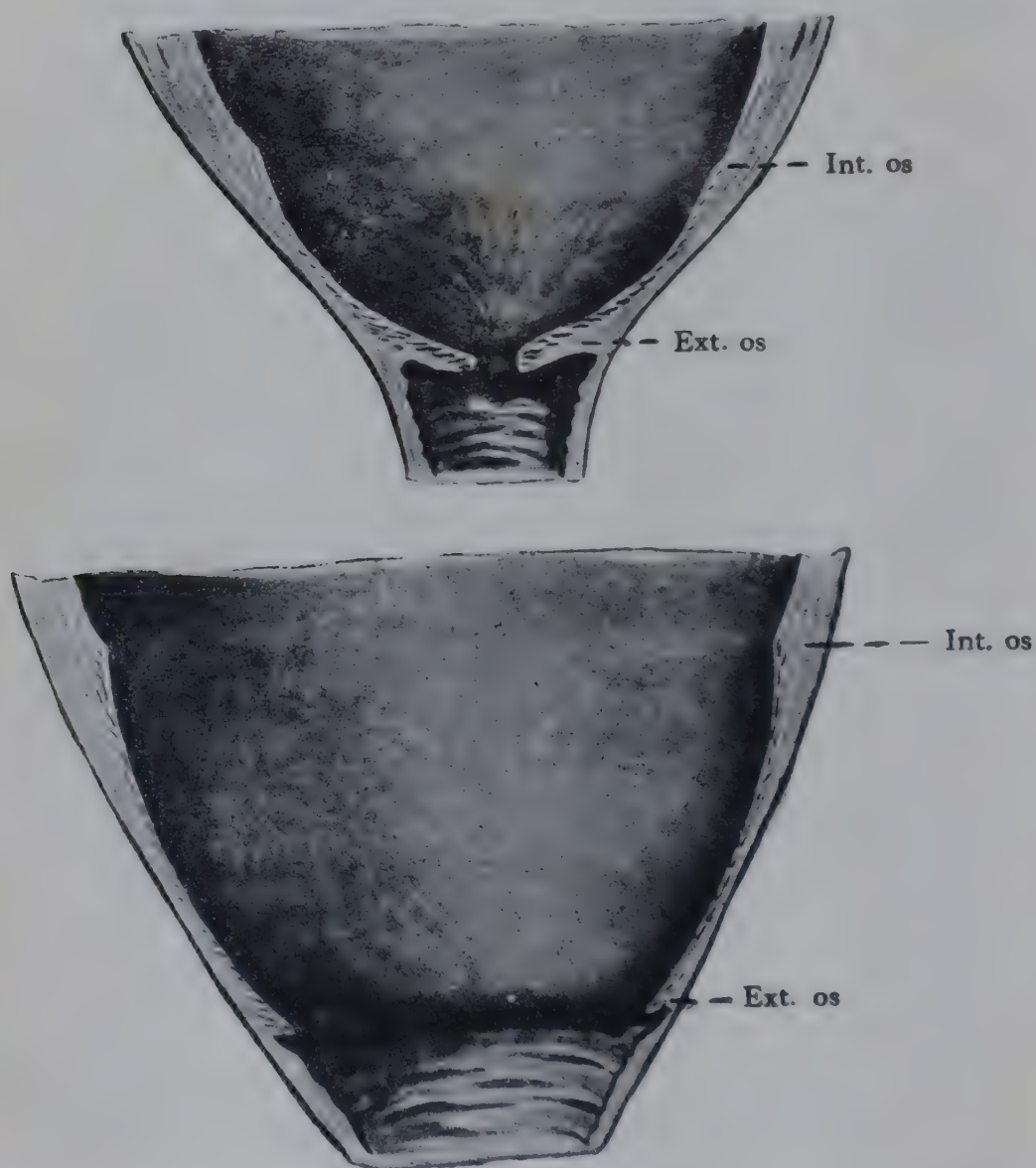


FIG. 33.—Further stages of dilatation of the cervical canal in a primigravida.

the mucus discharge is generally the operculum present at the cervical canal that gets loosened and discharged. This blood stained mucus is known as the 'show', and is valuable corroboration that accompanying pains are true labour pains.

Dilatation of the Cervix. This is the result of the contracting and retracting upper segment lifting up and thinning out the lower segment, ultimately pulling the cervix over the advancing presenting part without however significantly altering the level of the external os in the pelvis. A well fitting presenting part favours good uterine action and smooth dilatation of the cervix. The modern concept is

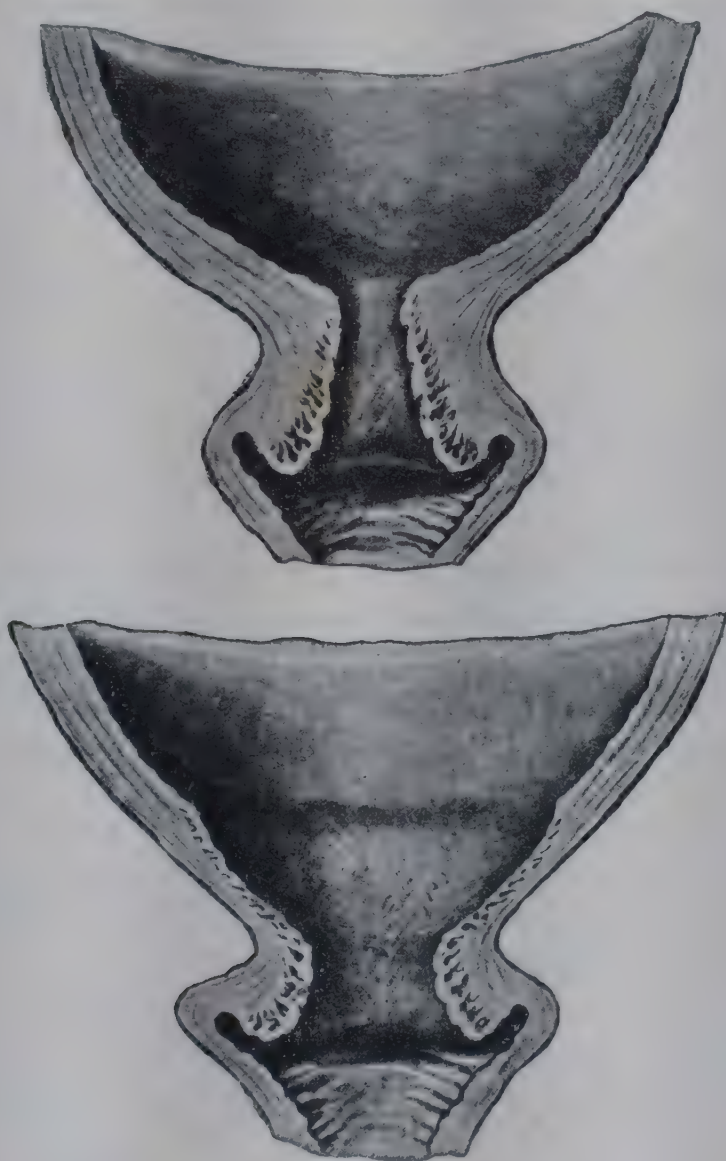


FIG. 34.—Stages of dilatation of the cervical canal in a multigravida.

that the bag of forewaters is not essential to the process of dilatation of the cervix. Especially after the rupture of the membranes the pressure exerted by the presenting part on the cervix induces reflex uterine contractions which are more powerful than before rupture. These further aid in more rapid dilatation. The upper part of the cervix is muscular while the lower half especially the external os is fibrous in its character. Dilatation of the external os therefore depends not only on the strong and co-ordinate action of the muscles but on its own capacity to soften and stretch. In turn this depends on its intrinsic

development and on its preparation during pregnancy. The hormones, œstrogen and progesterone, play a part in this preparation.

The Lower Uterine Segment. During labour, under the influence of uterine contractions, the uterus gradually becomes differentiated into two distinct portions. The upper segment is thicker and more active and becomes thicker as labour advances. The lower portion, *i.e.*, the lower segment with the cervix is passive and becomes thinner and stretched out to receive the descending fœtus as labour advances. The junction of the upper and lower segment is characterised by a ring of circular muscle fibres—the so-called physiologic retraction ring. Above this level is the contracting thick upper segment, and below, the dilating and stretching lower segment and cervix. This ring becomes very prominent in obstructed labour when it is termed the pathologic retraction ring or Bandl's ring.

The lower uterine segment is developed from the isthmus of the uterus which is defined as that portion of the non-pregnant uterus situated between the anatomical internal os and histological internal os, the former being higher. This area is said to grow as well as stretch during pregnancy. There are some who doubt the existence of the isthmus while others believe that the lower part of the corpus uteri has also a share in the development of the lower uterine segment in pregnancy. The lower segment is formed by the retraction of the upper segment which pulls up and thins out the tissue intervening between itself and a fixed cervix. The thinning that occurs in labour, of the lower segment, is due to the downward and outward thrust of the descending fœtus. The upper margin of the lower segment is about the level of the upper border of the symphysis pubis in late pregnancy and is indicated roughly by the line of close attachment of the utero-vesical fold of peritoneum.

The process of cervical dilatation differs somewhat in a primigravida from a multipara. At the commencement of labour in a primipara, the whole of the cervical canal is closed, both the internal and external os being occluded. The dilatation occurs progressively from above downwards, the internal os dilating first, then the cervical canal, and last of all the external os. In a multipara, on the other hand, at the commencement of labour, the external os is patulous, usually admitting freely one finger, sometimes more. The internal os is not quite so completely occluded as in a primigravida. The process of dilatation therefore is a little more rapid and easy, inasmuch as the dilatation of the internal os brings about a simultaneous dilatation of the whole cervical canal, the external os being already open.

In the majority of cases *the head becomes fixed* at this stage, if it has not already done so in the last two or three weeks of pregnancy.

Non-fixation of the head in cephalic presentation suggests the possibility of abnormalities.

The *membranes usually rupture* after full dilatation of the cervix, when the second stage commences.

Second Stage

The second stage, or the stage of expulsion, extends from the complete dilatation and rupture of the membranes, to the expulsion of the fœtus or fœtuses. This stage may last from one to two hours in a primigravida, and from half to one hour in a multipara.

The phenomena of this stage consist in :—

- (1) The occurrence of the characteristic uterine contractions.
- (2) The coming into action of the accessory muscles of labour.
- (3) The progressive descent of the presenting part.
- (4) The dilatation of the vagina and vulva with stretching of the pelvic floor.
- (5) The expulsion of the fœtus.

Uterine Contractions. The nature of the uterine contractions gradually changes, getting stronger in the second stage: they are more severe than in the first stage and are of a 'bearing-down' character. The voluntary muscles—the accessory muscles of labour—also begin to contract and exert their influence towards the end of the second stage. The diaphragm and the abdominal muscles begin to act and the patient clutches at anything she can get hold of. With each of these pains the fœtus is driven down through the dilated cervical canal, and the vagina relaxes and dilates to receive it. When the perineum is reached it is stretched so that it begins to bulge with every uterine contraction. The presenting part is now directed upwards and forwards, towards the orifice of the vulva by the pelvic floor. Between the pains, the soft parts press back the fœtus, till the presenting part is so firmly fastened under the symphysis pubis that it can no longer recede.

Lastly, there is the gaping of the vulva, when the presenting part is fixed under the symphysis pubis—the phenomenon known as 'crowning of the head' in vertex presentations. At this stage the patient feels an inclination to micturate and defecate. This is due to the pressure of the presenting part on the bladder and rectum. Lastly the head passes through the external opening, with a series of almost continuous uterine contraction, helped by involuntary straining efforts on the part of the patient, due to the action of the accessory muscles of labour. As expulsion of the head takes place the patient utters a sharp cry or groan and thereafter the rest of the fœtus is born.

Third Stage

The third stage, or the stage of placental delivery, is very important and should be carefully watched. This extends from the complete expulsion of the foetus to the complete expulsion of the placenta and membranes, and firm contraction and retraction of the uterus subsequently. The average duration of this stage, when spontaneously completed, may extend from a few to fifteen minutes.

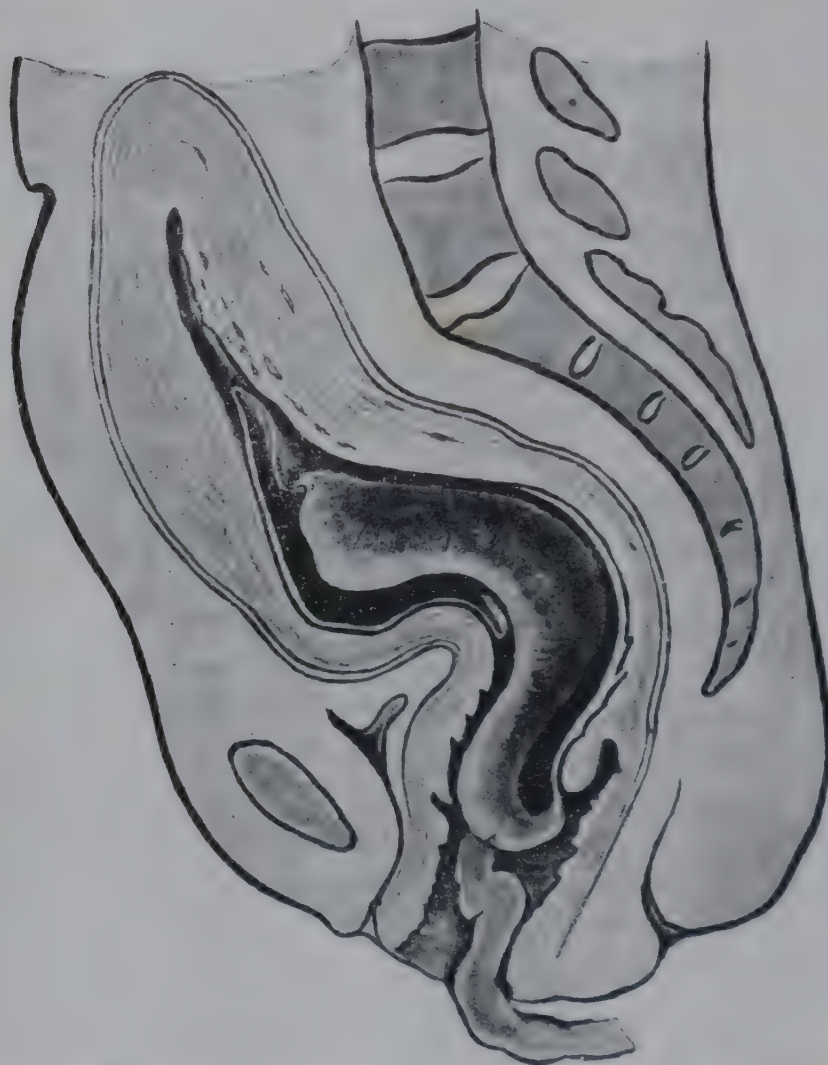


FIG. 35.—The mechanism of expulsion of placenta—Duncan's.

As soon as the birth of the foetus is over the woman feels relief and is calm and comfortable. Now and again there may be feeling of faintness, caused by the sudden evacuation of the uterus, especially after the delivery of a large-sized foetus, or when the uterine contents have been suddenly evacuated, as in a case of hydramnios or twins.

The phenomena of the third stage of labour are :—

- (1) The characteristic uterine contractions.
- (2) The separation of the placenta.

- (3) The expulsion of the placenta.
- (4) The control of hæmorrhage.
- (5) The permanent contraction and retraction of the uterus.

Uterine Contraction. After the completion of the second stage the uterus will be found almost at the level of the umbilicus, and is firm, round and hard. Rhythmic contractions will occur and the patient may sometimes feel the pains.

Placental Detachment. As the fœtus is being delivered, separation of the placenta may take place. The shrinkage of the placental

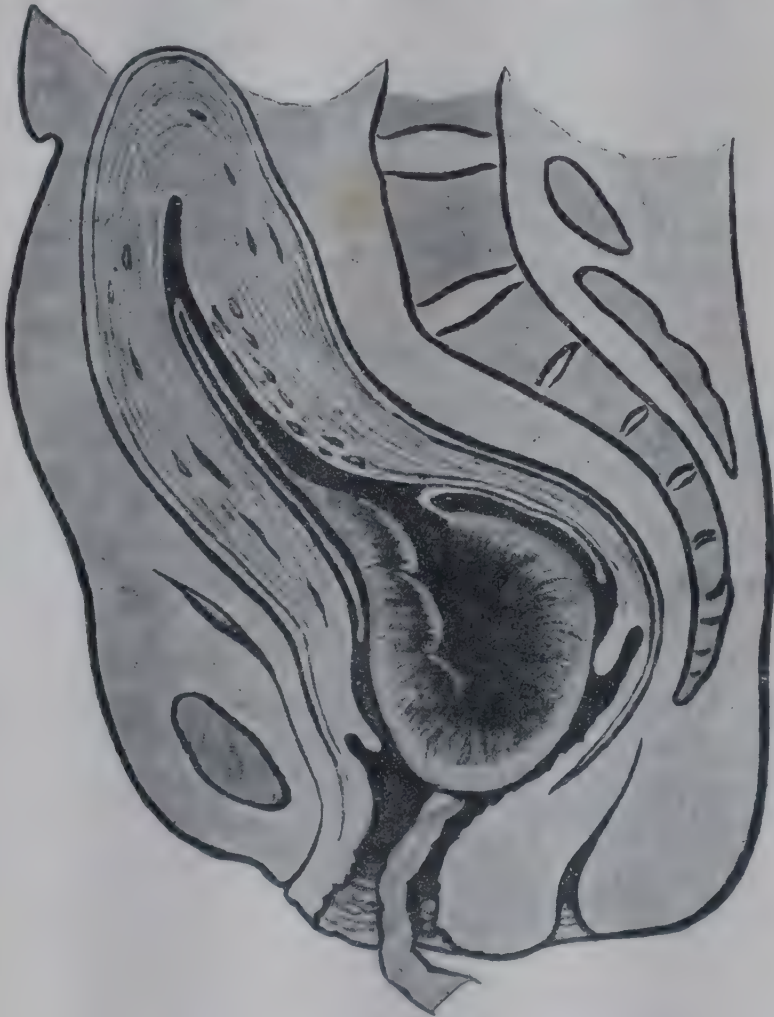


FIG. 36.—The Mechanism of expulsion of placenta—Schultze's.

site and the forcing downward of the whole placental mass by the uterine contractions may cause the separation. There are two methods by which placental expulsion may occur:—

(1) On account of the contractions of the uterus, the placenta may be folded on itself, so that the long axis of the placenta corresponds to the long axis of the uterus and the margin that presents at the cervix or vagina is the lower margin, showing perhaps a little of the fœtal surface.

(2) The second method is the one where the placenta may separate at its centre. A retroplacental hæmatoma is formed which, with each contraction of the uterus, forces more of the placenta to separate, and the placenta thus separated presents itself at the vaginal outlet, with the centre of its foetal surface with the attached cord, like an inverted umbrella.

It is of little significance which method of expulsion is responsible for its final delivery.

The expulsion of the placenta usually occurs within a few minutes after the birth of the foetus. During this period the uterus should be moderately hard, as the result of tonicity, so that when the placenta separates the contractions and retractions of the uterus will arrest hæmorrhage by closure of the placental sinuses. The control of hæmorrhage after separation of the placenta is due to three factors :—

- (1) The contraction and retraction of the uterus, constricting the vessels passing through the uterine wall to the placental site.
- (2) The occlusion of the torn vessels themselves.
- (3) The formation of blood-clots which favour the closure of the lumen of the vessels.

During the third stage and immediately after there is always a moderate amount of bleeding ; in a normal case it does not exceed 250 ml.

When labour is over the patient may occasionally have a rigor, which is purely a vasomotor phenomenon and is not indicative of infection, and is generally of no particular significance. It is termed the ' physiological chill '.

THE MECHANISM OF LABOUR

By this term is meant the manner by which the fœtus adjusts itself to and passes through the parturient canal with the minimum amount of difficulty.

The three factors concerned in labour are: the pelvis and soft parts, the fœtus and the uterine forces. The effect of each one of these and the pathological variations that may occur in any of them are material factors to be taken note of in the mechanism of labour. Contractions of the pelvis and abnormalities of the soft parts may be responsible for variations in the mechanism of labour. So also abnormalities in the position and presentation of the fœtus. Lastly, the uterine contractions may also cause abnormalities of mechanism.

Mechanism of Labour in a Vertex Presentation

We shall deal with the mechanism of labour in a vertex presentation, with the head in the first position, left occipito-anterior, with a normally sized pelvis and with a fœtus that is also average in size and weight.

Certain terms are used in connection with the mechanism.

Engagement. The term 'engagement' in normal labour denotes that the greatest diameter of the head has passed through the brim of the pelvis. In a vertex presentation, when engagement occurs, the lowermost portion of the vertex would be at the level of the ischial spines and only a small portion of the cephalic prominence will be palpable per abdomen.

The term 'fixation of the presenting part' is not synonymous with engagement. It means that a portion of the presenting part is entering into the superior strait. The surrounding structures and abdominal muscles help in fixing a presenting part. In primigravida, fixation and engagement occur usually during the last few weeks of pregnancy, while in multiparæ, it ordinarily does not take place until after the commencement of labour.

It is traditional to define the position of a vertex presentation with reference to one of the four quadrants of the pelvis. Before radiological examinations were available, definition of the exact position

of the head was only possible by vaginal examination after labour was established and cervix dilated. Radiological investigations show that the head is in transverse position in nearly 70 per cent of cases, irrespective of whether the head is unengaged or in midpelvis.

Since occipito-transverse positions are the more common, the mechanism of labour in such position is discussed. The adaptation or accommodation of the foetal head to the pelvic cavity and ultimate delivery of the foetus are brought about by certain movements and constitute the mechanism of labour. The cardinal movements are: engagement, descent, flexion, internal rotation, extension, restitution and external rotation. Uterine contractions bring about important modifications in the attitude of the foetus especially after the head has descended into the pelvis.



FIG. 37.—Moulding and caput in a vertex presentation.

A normally-sized head usually does not engage with its sagittal suture directed anteroposteriorly. As the transverse and oblique diameters are larger than the anteroposterior, it usually enters in either of these diameters but mostly as has been stated in the transverse diameter.

The sagittal suture while remaining parallel to the transverse axis of the pelvic inlet may not lie exactly midway between the sacral promontory and the symphysis pubis. Frequently it is deflected either posteriorly to approach the sacral promontory or anteriorly to lie nearer the symphysis pubis. To this the term *asynclitic engagement* is applied.

When the sagittal suture lies nearer the symphysis, the posterior parietal bone becomes the leading presenting part. It is then termed

posterior parietal presentation or posterior asynclitism (Litzman's obliquity). When the sagittal suture is nearer the sacral promontory,



FIG. 38.—Synclitic engagement of the head.

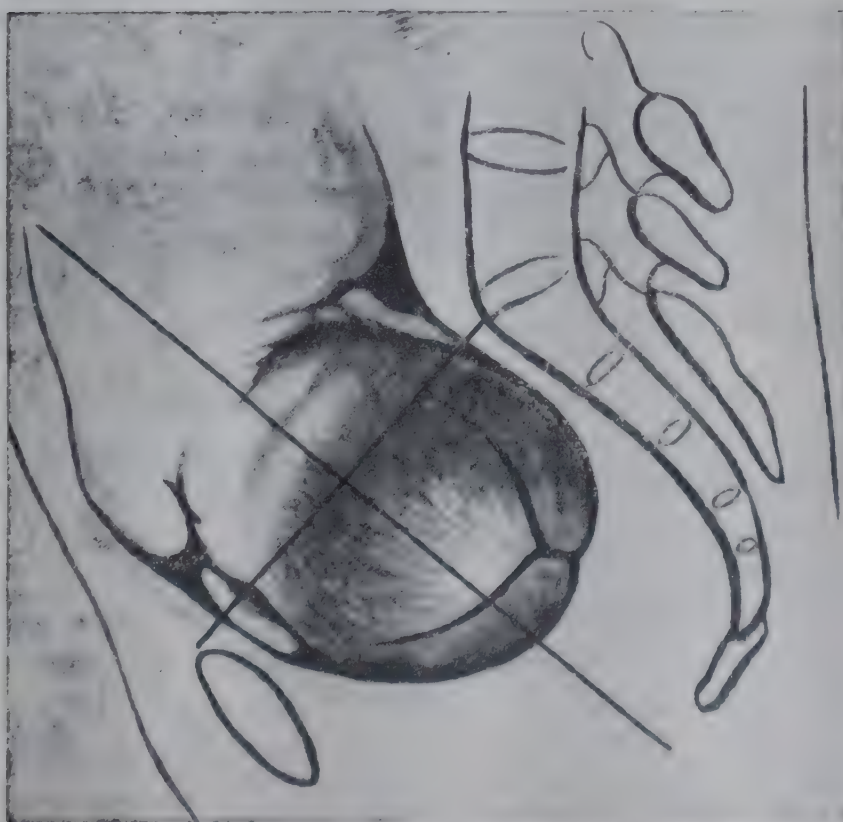


FIG. 39.—Anterior synclitism (Nægele's obliquity).

an anterior parietal presentation results. This is termed anterior asynclitism or Nægele's obliquity. Moderate degrees of asynclitism are the rule in labour.

Descent. In the absence of any cephalopelvic disproportion the head descends deeply into the pelvis, which occurs occasionally even prior to or early in labour in a primigravida. In a multipara however descent begins with engagement and in both cases descent occurs throughout the mechanism of labour. Descent is brought about by (1) intrauterine fluid pressure, (2) uterine contractions and downward pressure of the fundus on the breech (Fœtal axis pressure). In the common occipito-transverse position for descent to occur the neck bends sideways and the anterior parietal bone slips behind the symphysis while the posterior parietal bone remains more or less stationary at or below the promontory.

Flexion. Flexion results as soon as the descending head meets with resistance whether it be from the pelvic side wall or pelvic floor. The chin gets into more intimate contact with the thorax thereby bringing the suboccipito-bregmatic diameter to engage instead of the occipito-frontal diameter.

Internal rotation. By this movement the occiput gradually moves from the position which it originally occupied towards the symphysis pubis or at times towards the hollow of the sacrum. For the completion of labour internal rotation is absolutely essential. In the transverse and anterior position it occurs from left to right in left occipito-transverse or anterior position and from right to left in right transverse or anterior position. Exceptionally in occipito-posterior position the occiput rotates into the hollow of the sacrum. Internal rotation is associated with the descent of the presenting part and is usually not effected, until the head has reached the level of the ischial spines as demonstrated by X-ray studies.

No explanation of the movement of internal rotation is convincing. The most satisfactory is that which attributes the movement to the tonic resistance of the levator ani muscle. According to this view the occiput is forced into a gutter the sides of which are formed by the two halves of the levator ani muscle. The direction of the gutter is downwards and forwards ending beneath the pubic arch. During a pain the contracting uterus drives down the head stretching the levator ani but more particularly the half in relation to the occiput as the latter is situated at a lower level in the pelvis than the sinciput. Elastic recoil of the muscle follows the end of the pain. The occiput thus at each contraction and relaxation is pushed inwards towards the middle line

and ultimately the occiput lies directly under the symphysis. The forward incline of the walls of the pelvic cavity, the impetus given by the spines of the ischium and effective uterine contractions are other factors influencing internal rotation. This movement brings the diameter of engagement of the foetal head to the longest of the pelvic outlet available, namely, the anteroposterior diameter. In transverse positions it has to rotate through one-half of a circle while in certain other positions the occiput rotates through nearly one-eighth of a circle to bring the occiput under the symphysis.

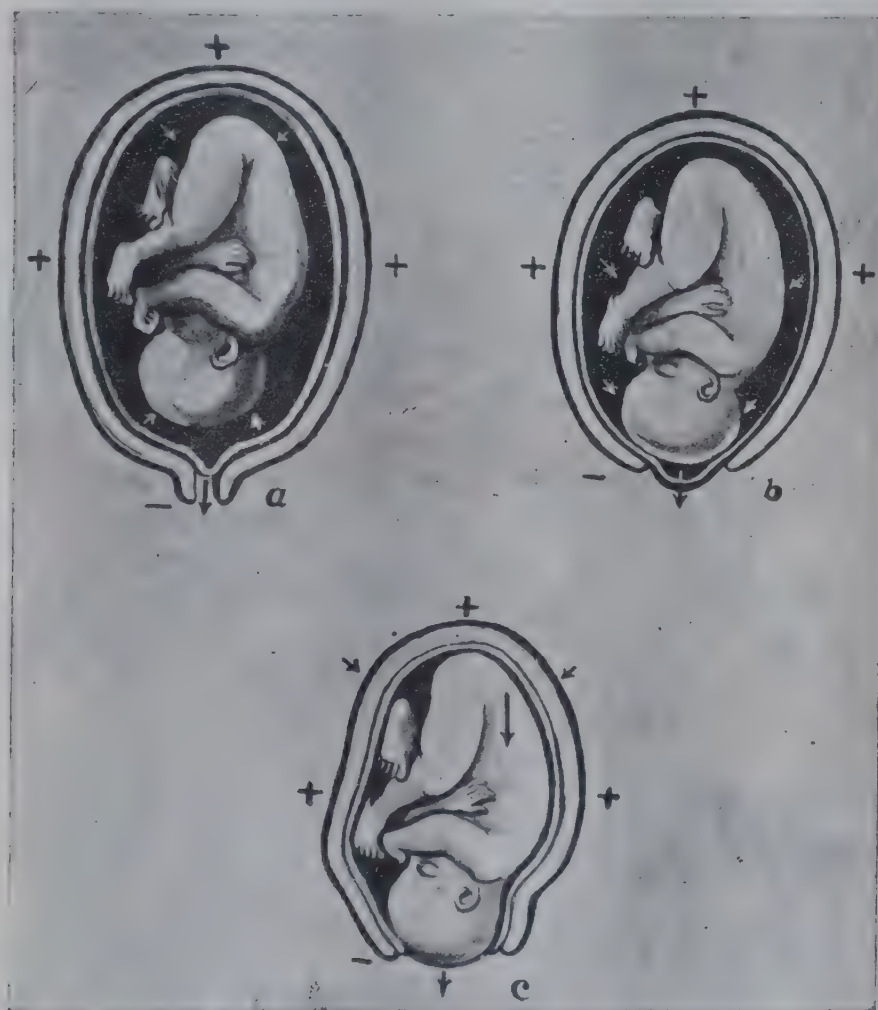
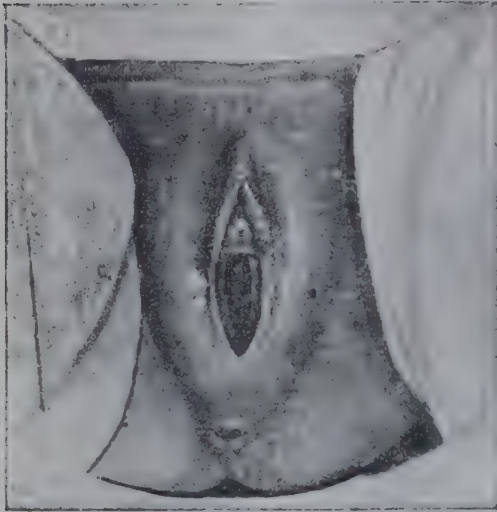


FIG. 40.

a. General fluid pressure. *b.* Cervical canal; the least resistant area is seen yielding. *c.* Foetal axis pressure after rupture of the membranes.

In those cases where deficient flexion fails to cause the occiput to be the most dependent part, rotation of the occiput forwards may not occur. Also, where there is a deficiency of the pelvic floor from previous lacerations, rotation may be rendered difficult or delayed. Lack of uterine contractions, or weak pains, may prevent the completion of internal rotation: hence prolongation of the second stage of labour may occur, necessitating artificial aid.

Extension and Birth of the Foetal Head. When internal rotation is completed the occiput comes to lie underneath the symphysis pubis, and the head is in an attitude of flexion. Subsequent uterine contractions favour the next movement so essential for the birth of the head, namely, extension. Extension is the resultant of two forces, the effect of the uterine contractions from above and the elastic resistance of the pelvic floor from below.



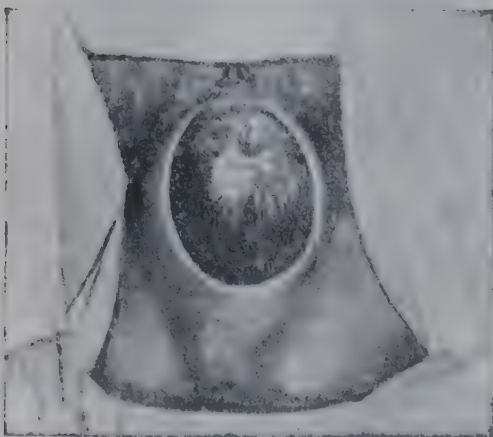
(a)



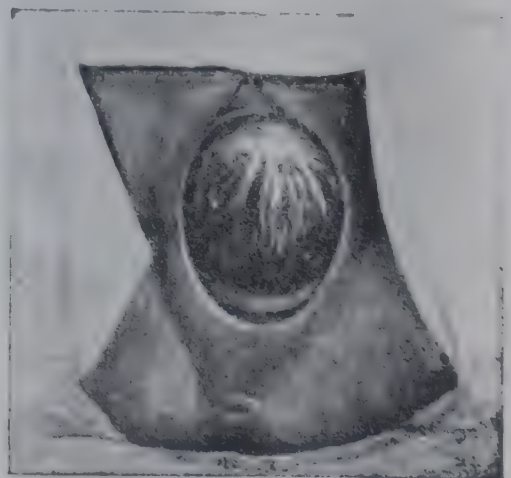
(b)

FIG. 41.—Second stage: the head stretching the perineum.

As a result of extension the occiput hitches against the symphysis pubis, the face sweeps over the perineum, and the successive parts of the foetal head to be born are the sinciput, the orbital ridges, nose



(a)



(b)

FIG. 42.—Delivery of the head.

(a) Crowning.

(b) Head emerging at the outlet.

Note the stretching of the perineum.

mouth and chin. At this stage the perineum is stretched, and if proper support is not available, or if the head descends too rapidly in the process of extension, the perineum may be torn—the degree of

the tear depending upon the force with which the head comes down, the rapidity with which the perineum is stretched and the particular diameter of the head that stretches the perineum.

An abnormal mechanism may show up for the first time at this stage, as in occipito-posterior positions, where internal rotation has

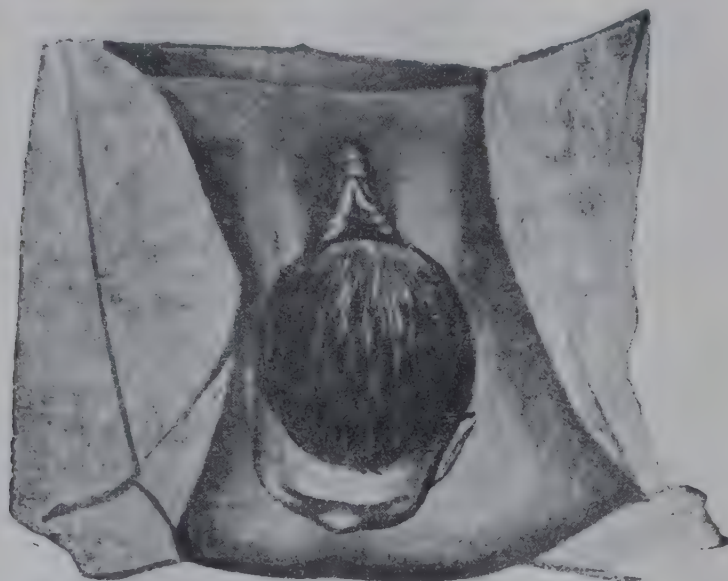
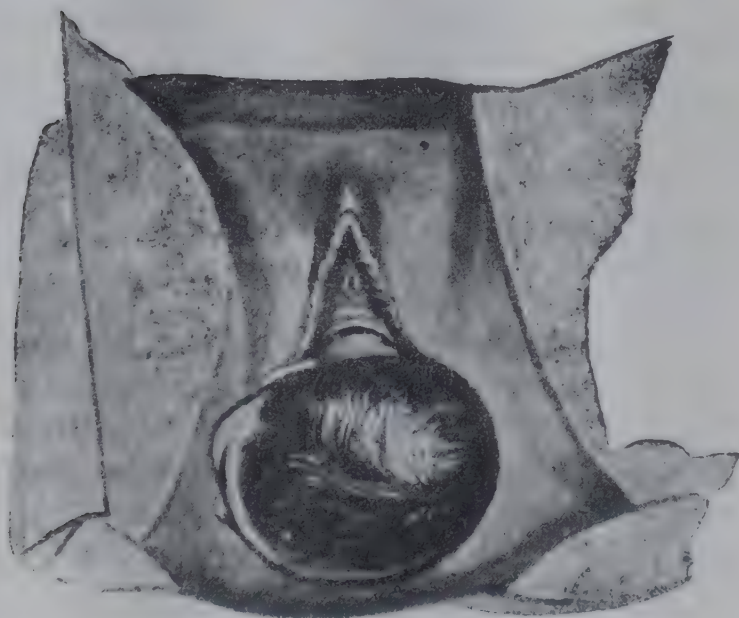
**A****B**

FIG. 43.—Delivery of the head.

- A. Extension completed.
- B. External rotation.

resulted in the occiput lying in the sacral hollow, the head being delivered with face to pubis.

Restitution. As soon as the head is free outside the vulval outlet it rotates through one-eighth of a circle, and thus the neck is untwisted

and the chin rotates towards the right side in cases of left occipito-anterior positions and towards the left in cases of right occipito-anterior positions.

External Rotation. After the untwisting of the neck has occurred, the next movement is one of internal rotation of the shoulders, bringing the bisacrominal diameter into the antero-posterior diameter of the pelvic outlet. The anterior shoulder is now underneath the symphysis pubis. External rotation of the head occurs simultaneously with this movement. In the left positions of the occiput the head turns further towards the mother's left, until the face points directly to the right thigh ; and in the right position of the occiput the head turns in the reverse direction.

Restitution and external rotation frequently occur in such quick succession that they may practically appear to be one continuous movement ; but if a careful observation be made it will be found that restitution occurs first, and after a short interval external rotation takes place.

Once the shoulders have rotated into the antero-posterior diameter of the outlet, descent continues with the uterine contractions, until the anterior shoulder hitches underneath the symphysis pubis and the posterior shoulder sweeps over the perineum by a process of latero-flexion of the spine and is delivered first, followed a little later by the slipping forward of the anterior shoulder from underneath the symphysis pubis. After the expulsion of the shoulders the foetal body slips down through the pelvic cavity and the rest of the body is thus delivered.

During the next stage the placenta and membranes become separated from the uterine wall and are then extruded through the vaginal outlet, by one of two methods of expulsion already described. With the separation of the placenta, and sometimes with its extrusion, a certain amount of bleeding occurs, associated with slight pains. Once the placenta has been expelled, the uterus contracts and retracts till it becomes as hard as a cricket ball, and bleeding completely stops.

CONDUCT OF NORMAL LABOUR

IT is important to realise that labour is a physiological process, and that in the majority of cases nature completes the delivery without any artificial aid. The attitude of the obstetrician has been described as 'one of masterly inactivity and watchful expectancy'. Nowhere is there greater need than in obstetrics to desist from the temptation of interfering too frequently or prematurely. 'Meddlesome midwifery' is responsible for a great deal more of maternal morbidity and a fair proportion of maternal mortality than any other factor; and in the stress of modern life, with its preoccupations, there is the danger that the obstetrician may be inclined to interfere with nature and complete the process of labour, either because of the time natural delivery is to take or because of insistent demands by the patient or her relatives. Looked at from the larger point of view, and particularly with regard to the future of the patient, it must be conceded that the maximum amount of safety, both at the time of confinement and later, lies in the minimum amount of interference. Though it is desirable to allow nature to complete the process of delivery, one should not wait too long lest some permanent damage should occur to the fœtus or to the mother from lack of timely assistance.

Preparation of the Patient. If the patient is not having strong pains, and the membranes are intact a soap and water enema is given. The pubic hair and vulva are shaved and cleaned with an antiseptic and a bath given if considered necessary.

A general and obstetric examination is then carried out. The latter is essentially designed to elicit the presentation, position and station of the presenting part, the condition of the fœtus as ascertained by auscultation of the fœtal heart and to identify any abnormalities.

A vaginal examination would be indicated in all primigravida seen for the first time in labour, and in those in whom obstetric examination has revealed abnormalities or resulted in indefinite findings. It may also be necessary in cases where there is doubt regarding the rupture of the bag of waters. When an examination has been decided upon it should be carried out with all aseptic precautions.

The vaginal examination should ascertain the nature and dilatation of the cervix, the presence or absence of membranes, the position and station of the presenting part in relation to the ischial spines, the presence or absence of a caput, the moulding of the head, all

about the pelvic capacity and pelvic architecture and the presence or absence of any cephalo-pelvic disproportion (discussed in detail in the chapter on contracted pelvis).

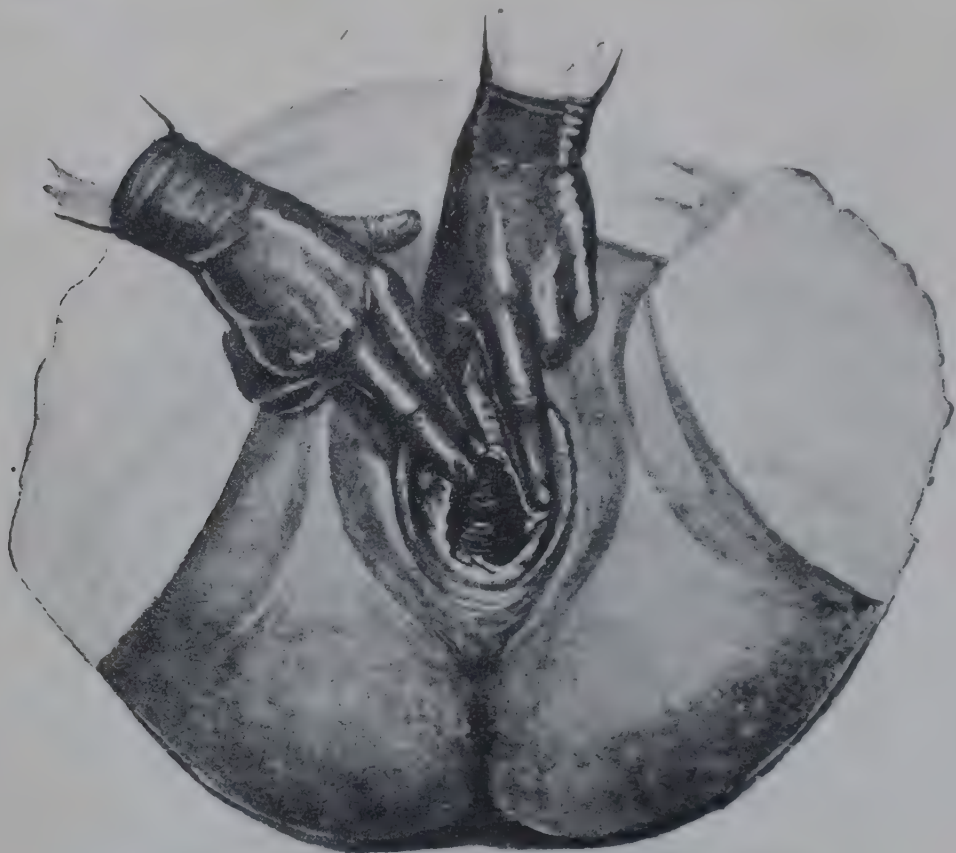


FIG. 44.—Method of making a vaginal examination.

Note the direction in which two fingers are introduced into the vagina.

Vaginal examination need not be resorted to, to ascertain the descent of the presenting part, as it can be done by abdominal palpation. In normal labour there should seldom be any necessity for a vaginal examination. But if necessity arises it should not be avoided. If properly carried out and restricted, vaginal examination under modern conditions is not hazardous to the mother.

Management of the First Stage. Having done all the preliminary examinations, the obstetrician should now be in a position to know whether the patient is having true pains or not. The signs and symptoms of labour are :—

- (1) The occurrence of labour pains simultaneously with contractions of the uterus; the pains are generally felt in the back and transmitted towards the front and lower part of the abdomen.
- (2) The occurrence of the 'show'. This is a discharge of mucus, often mixed with blood due to the separation of the mucous-plug filling the cervix, the blood coming from the surface left bare by the separation of the membranes.
- (3) The presenting part is now fixed in a multipara.

- (4) An internal examination reveals that the cervical canal is dilating.

In the absence of any evidence of dystocia due to maternal or foetal causes, the attitude of the obstetrician should be one of watchful expectancy. The patient should be allowed to walk about in the first stage. During the first stage, the progress of labour is assessed by noting the relationship of the head to the brim of the pelvis by careful palpation by the second pelvic grip. The relative position of the occiput and sinciput gives an idea of the degree of flexion. In vertex presentation with full flexion, the last portion of the head to sink into the pelvis is the sinciput so that if the sinciput is palpated periodically and its descent noted, the progress of labour can be determined. The maternal condition is watched carefully, temperature and pulse rate are recorded every four hours. The foetal condition is noted by recording the foetal heart rate every hour.

During the first stage the patient should be encouraged to take small quantities of liquid nourishment at intervals, such as plain milk, broth, soup, fruit juice, etc. It is better to avoid any solid food, because if the patient should be given an anæsthetic it is likely to cause nausea and vomiting. Later in the first stage, when the pains recur at short intervals the patient should be put to bed. Sedatives may now be administered for the relief of pain. If labour starts at night it is well to give a mild hypnotic so as to avoid a sleepless night. As the uterine contractions increase in severity, the membranes will bulge and usually rupture spontaneously when the cervix is fully dilated.

Management of the Second Stage. This stage begins with full dilatation of the cervix and rupture of the membranes, and ends with the complete expulsion of the foetus or foetuses.

Care must be taken to see that the bladder is not distended. The patient is encouraged to pass urine failing which she should be catheterised.

Towards the end of the second stage when the expulsion of the foetus is approaching, the patient is placed in the dorsal position, and she should be encouraged to 'bear down' during the pains; she should be instructed to hold her breath and bear down as a contraction reaches its height.

The foetal heart-beat should be taken every fifteen minutes after the rupture of the membranes. The time when the membranes rupture should be noted and the duration of the second stage should not be allowed to be unnecessarily prolonged without carefully re-examining the patient and ascertaining any abnormal factors that may be responsible for the delay.

In normal labour this stage does not exceed one hour. The pains become more frequent, they last much longer, and towards the end

of the second stage the 'bearing-down' pains commence ; at this time the head presses against the perineum and the anus begins to dilate. It is now that the obstetrician should give the necessary assistance. Before doing so he should put on sterile mask, gown and gloves after proper scrubbing and washing his hands. The most important task in the management of the second stage is the prevention of perineal lacerations. By avoiding such perineal lacerations the puerperium will be rendered safer, as possibilities of sepsis are distinctly less where the perineum is intact ; and the number of gynæcological complaints at a later stage will also be reduced. Perineal lacerations can be avoided by preventing too rapid an expulsion of the head, by promoting flexion of the head and delivering the head in between uterine contractions.

To prevent too rapid expulsion of the head, the patient should be induced to refrain from bearing down, to open her mouth and breathe deeply during the emergence of the head. At this stage a light anæsthetic may be invaluable, as it relieves the patient of the most excruciating pains of delivery and helps the more gradual progress of the head. If there is a tendency for the head to advance too rapidly, counter-pressure should be applied to prevent it from slipping out suddenly.

To promote normal mechanism of delivery and thus favour the smallest diameter of the head to emerge through the outlet it is necessary to see that extension of the head does not occur till the occipital protuberance is well underneath the symphysis pubis.

The delivery of the head between the uterine contractions is distinctly advantageous. With a relaxed perineum it is easier to deliver the head gradually and thus control its progress at the outlet much more successfully.

How to save the Perineum. When therefore the head crowns the vulval outlet the obstetrician, standing on one side of the patient, places the palmar surface of the fingers of one hand over the crowning vertex and with a sterile pad in the palm of the other hand he supports the perineum. The hand over the vertex, by applying pressure, prevents the

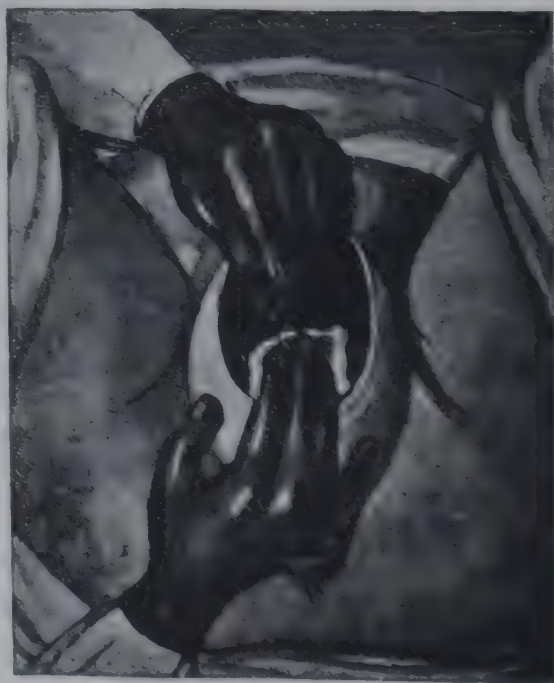


FIG. 45.—Method of delivery of the head avoiding undue stretching of the perineum.

head from being born during a contraction, while the hand over the perineum helps to ease the vertex out of the vulval outlet. In primigravid women, some obstetricians resort to routine episiotomy but this is not necessary unless a tear is inevitable. In



FIG. 46.—Method of protecting the perineum.

some cases it may be found impossible to prevent lacerations of the perineum. This may be either in operative deliveries or even in normal deliveries. The outlet may be so narrow and the perineum may not stretch sufficiently to allow the head to be born without a tear.

Episiotomy may be either lateral, mediolateral or central. We perform mediolateral episiotomy more often than central. Lateral episiotomy is not recommended. In doing the mediolateral episiotomy, the timing is important. It should be done when the head

is crowning the vulva and does not recede into the vagina when the contractions pass off. It should start at the midpoint of the lower vulvar rim and should be inclined to the midline only by about 15° - 20° either to the right or left and should be directed towards the ischial tuberosity. The aim is to avoid the anal sphincter. Central episiotomy is a useful procedure and it cuts right down in the middle of the perineum. Its disadvantage is that if the incision extends while delivering the baby, it may involve the anal sphincter. The length of the perineum varies in different individuals. If it is small, central episiotomy will be disadvantageous. Hence much depends on the obstetrician's judgment. Mediolateral episiotomy has no such disadvantages. However, healing is more perfect with a central episiotomy.

The episiotomy wound should be carefully sutured in layers after the placenta is expelled. It is preferable to do both the episiotomy and the suturing under local infiltration anæsthesia.

After the delivery of the head, the eyelids of the child should be cleaned by means of soft linen soaked in sterile water or boric acid solution; separate wipers should be used for each eye and the lids washed. A piece of gauze should then be used to wipe the lips and nose, and the little finger wrapped with a piece of soft linen should be passed into the child's mouth and any accumulated mucus re-

moved therefrom. It is preferable to aspirate the mucus with a soft rubber or plastic catheter. If the cord is round the neck it may be slipped over the head, down the shoulder ; or cut between clamps.

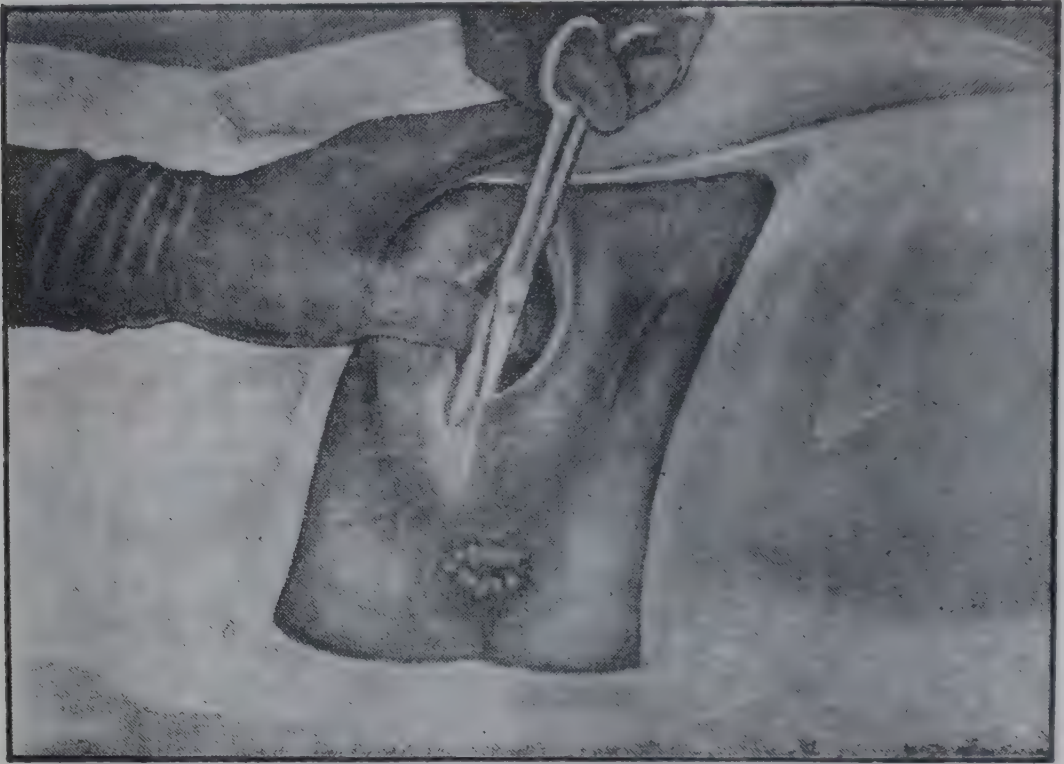


FIG. 47.—Mediolateral episiotomy.

Delivery of the Shoulders. After the head is born it is better to wait for the next pain to expel the shoulders by natural powers. During this interval the movements of restitution and external rotation will take



FIG. 48.—Delivery of the shoulders in a vertex presentation.

place. The anterior shoulder will then hitch against the symphysis pubis, and the posterior shoulder will be born. It is necessary to take care of the perineum during the delivery of the shoulders, as in some cases, either because of a rapid delivery, or because

of an increase in the size of the bisacromial diameter, the perineum is lacerated. Delivery of the shoulders should be delayed till complete rotation of the bisacromial diameter has taken place. The head should be held in the hand and gently depressed downwards, so as to get the anterior shoulder well underneath the symphysis pubis. It should then be gently raised up so as to allow the posterior shoulder to be delivered first. As far as possible, delivery of the shoulders should be helped by gentle traction of the head upwards for the posterior shoulder and downwards for the anterior shoulder. It is not desirable to apply traction to the axilla, as the chances of fracturing the humerus are by no means negligible.

Delivery of the Body. After delivery of the shoulders, the body as a rule is rapidly expelled. Should there be delay, however, the thorax may be held by the hand and gentle traction applied.



FIG. 49.—The position of the child immediately after delivery.

As soon as the child has been delivered it should be placed on its side in between the legs of the mother, covered with a dry towel or a warm blanket, and the chest gently compressed. This will help to make the child cry vigorously, thus establishing respiration. Should there be any delay in the establishment of respiration or in any case in which there may be liquor, mucus or meconium in the pharynx, the air passages should be carefully cleared by aspiration with a rubber or plastic mucus catheter.

Ligation of the Cord. Once the child has begun to cry there is no hurry to ligate the cord until pulsations cease. The foetus gets 80-100 ml. of maternal blood during this period, which is

of invaluable help in its growth. To note whether the cord has stopped pulsating or not, it should be grasped between the index finger and the thumb at the vulval outlet. It is desirable gently to draw out the cord a little, so that no loops lie in the vagina. Once the pulsations have stopped the cord should be ligatured in two places, one ligature about 3-4 cms. from the umbilicus, and the second as close to the vulval outlet as possible. The second ligature avoids the possibilities of hæmorrhage from the cord in cases of twins. It also helps to find out the lengthening of extra-vulval portion of the cord during the third stage. The cord is now divided close to the umbilical ligature, and this is best done by taking the cord in the hollow of the palm and cutting it with scissors passed between the second and third fingers to avoid injury to the actively moving extremities of the child. After cutting the cord, the stump should be examined to see that there is no bleeding, and it may be touched with some antiseptic and dressed with sterile absorbent cotton or gauze and a bandage tied round the navel. After the cord has been ligated the child should be taken up with care, placed in the cradle and wrapped in some warm material.



FIG. 50.—Method of lifting the new-born baby.

As soon as convenient, after the child has been separated, the eyes and lids should again be wiped clean, washed with saline water, a drop of 1% silver nitrate solution or a drop of penicillin ophthalmic solution 5000 units to 1 ml. put in or penicillin ophthalmic ointment applied. This routine practice is very desirable to prevent ophthalmia neonatroum.

Perineal Lacerations. Once the child has been removed to the cradle, the perineum should be carefully examined in good light with the patient in the dorsal position to note any lacerations. It is not sufficient to examine only the skin, as deep lacerations may sometimes be present which it is always desirable to suture immediately after the labour is over.

Management of the Third Stage. By far the most important stage of labour to manage in a case of normal delivery is the third stage. A careful watch should be kept over the condition of the uterus, the condition of the patient, the amount of hæmorrhage, if any, and the signs of separation of the placenta.

How to ascertain if the Placenta has separated. The following signs and symptoms help to assist one in determining whether the placenta has separated from the uterus or not :—

- (1) The patient will complain of pains associated with uterine contractions.
- (2) There will be a slight amount of vaginal hæmorrhage.
- (3) The extra-vulval portion of the cord will lengthen.
- (4) The fundus of the uterus will rise above the umbilicus.
- (5) There will be a soft elevation above the symphysis with a depression immediately above, indicating that the placenta has separated from the fundus and is lying in the lower uterine segment.
- (6) If the fundus of the uterus is gently grasped and raised the cord will not recede if the placenta has separated ; whereas if the placenta is still adherent to the uterus the portion of the cord just outside the vulva will be drawn into the vagina.

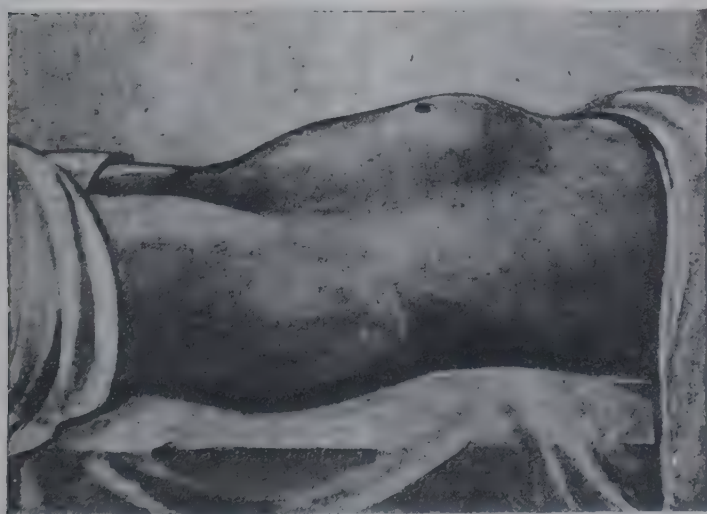


FIG. 51.—The third stage of labour.

Note the slight elevation due to the expulsion of the placenta into the lower uterine segment.

The chief objects in view during the management of the third stage should be : to promote natural separation of the placenta and membranes and their complete expulsion ; to arrest hæmorrhage

and to secure good and permanent contraction and retraction of the uterus.

During recent years there has been a certain change in the obstetrician's attitude towards the management of the third stage. This has been brought about by a proper understanding of the physiology of placental separation. Investigations have shown beyond doubt that there are two factors involved in the third stage—(a) the stage of placental separation and (b) the stage of placental descent. Evidence is to hand which proves that normally the placenta separates within two to five minutes of the birth of the baby and that what were previously designated as signs of placental separation are really signs of placental descent. In other words, the placenta separates some time before signs of descent are detected.

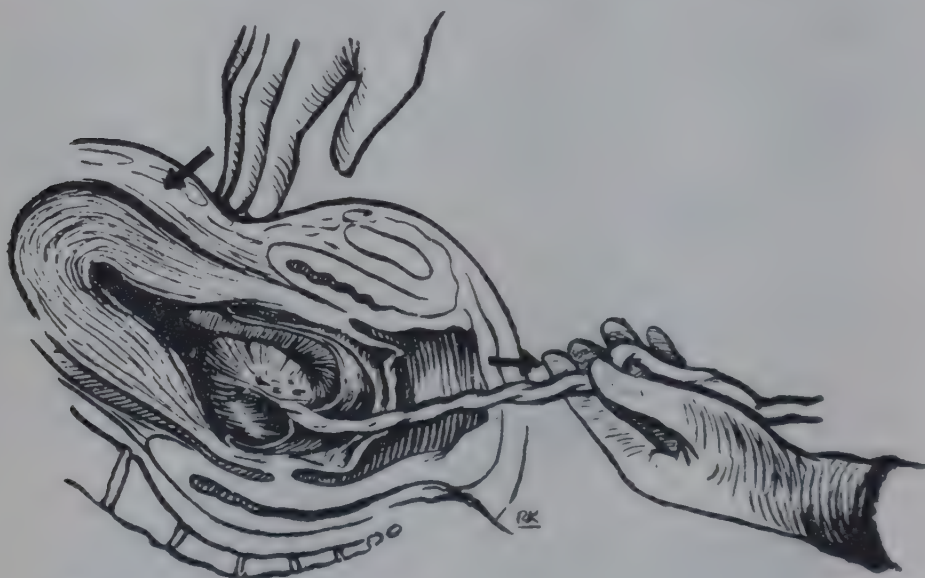


FIG. 52.—Delivery of the placenta by traction on the cord.

The most important factor in placental separation is the strong contraction and retraction of the uterus. Anything which will enhance and accelerate the uterine action should not only help in accelerating the separation of the placenta but should also help in controlling the amount of blood loss in the third stage. It is based on these principles that a new technique has come into being in the management of the third stage.

As the baby's head is being born 0.25 mgs. of Methergine or Ergometrin is injected intravenously into the patient and the delivery of the shoulders and body proceeded with slowly taking about two to three minutes. By the time the delivery is completed, the placenta will be found lying separated and can be expressed straightaway. The amount of blood loss is minimal and this is certainly of great advantage to an anæmic woman. Oxytocin intra-muscularly can be used instead of Methergine. But Methergine is preferable to oxytocin. It

can be given intra-muscularly also. The only danger in this method is that occasionally the drug may cause an hour-glass spasm of the uterus and give rise to retention of the placenta.

While one need not necessarily resort to this type of management of the third stage as a routine, it is indicated in all cases where one anticipates post-partum hæmorrhage or where the mother's general

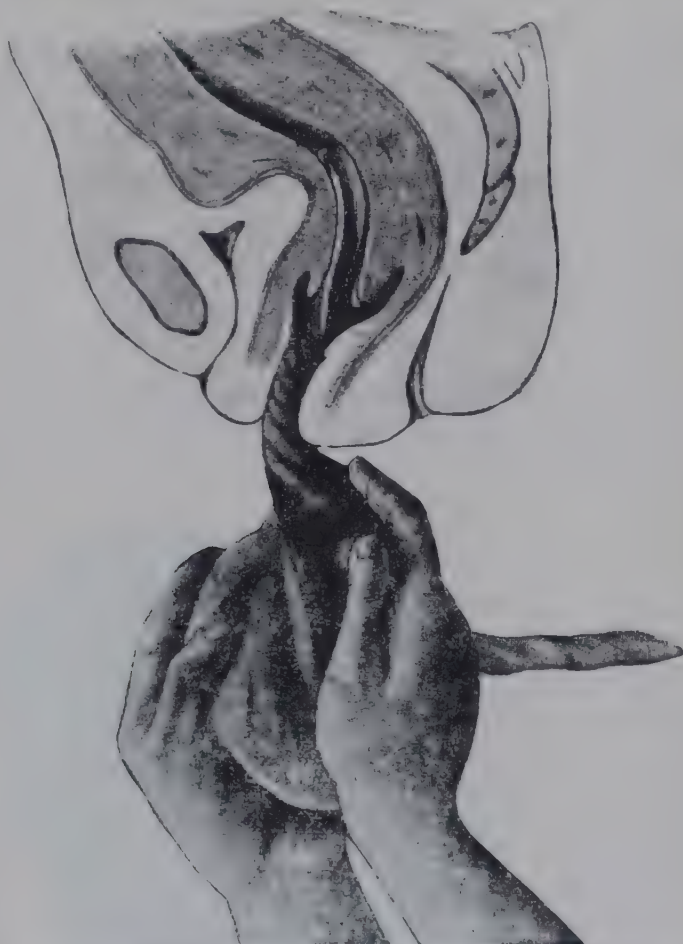


FIG. 53.—Third stage of labour. Method of receiving the placenta.

condition indicates that even a normal blood loss in the third stage may affect her adversely, as in patients with severe anæmia, multiparity, multiple pregnancy or hydramnios.

A modified technique of delivering the placenta is very commonly used. From the time the baby is born until the expulsion of the placenta, it is desirable to place the left hand lightly on the fundus of the uterus but without kneading or massaging. The hand over the fundus will indicate the condition of the uterus and will help in recognising cases where the uterus fills up with blood without much external loss.

When the placenta has completely separated and is lying loose in the lower uterine segment and upper vagina, it is expressed. The left hand which is on the fundus gently massages the uterus to make it contract and pushes the contracted uterus firmly while the right hand

holds the cord up to take off the weight of the emerging placenta. If there is any slight difficulty or if the membranes do not come off readily, the left hand is removed from the fundus and its fingers are sunk into the abdominal wall above the pubis, the uterine body being thus drawn up. Gentle traction on the cord in the axis of the vulval outlet delivers the placenta easily and completely. If any bit of membrane is found sticking, it is twisted into a rope and gently removed.

This practice is in a sense a revival of the old practice of traction on the cord. There is one difference however and that is this is never done and should never be attempted unless one is certain that the placenta has completely separated from the upper uterine segment. Under such circumstances this technique is ideal. The danger of inversion will be present only if traction is done when the placenta has not yet separated from the uterus completely.

Examination of the Placenta and Membranes. As soon as the placenta and membranes have been expelled and received in a basin

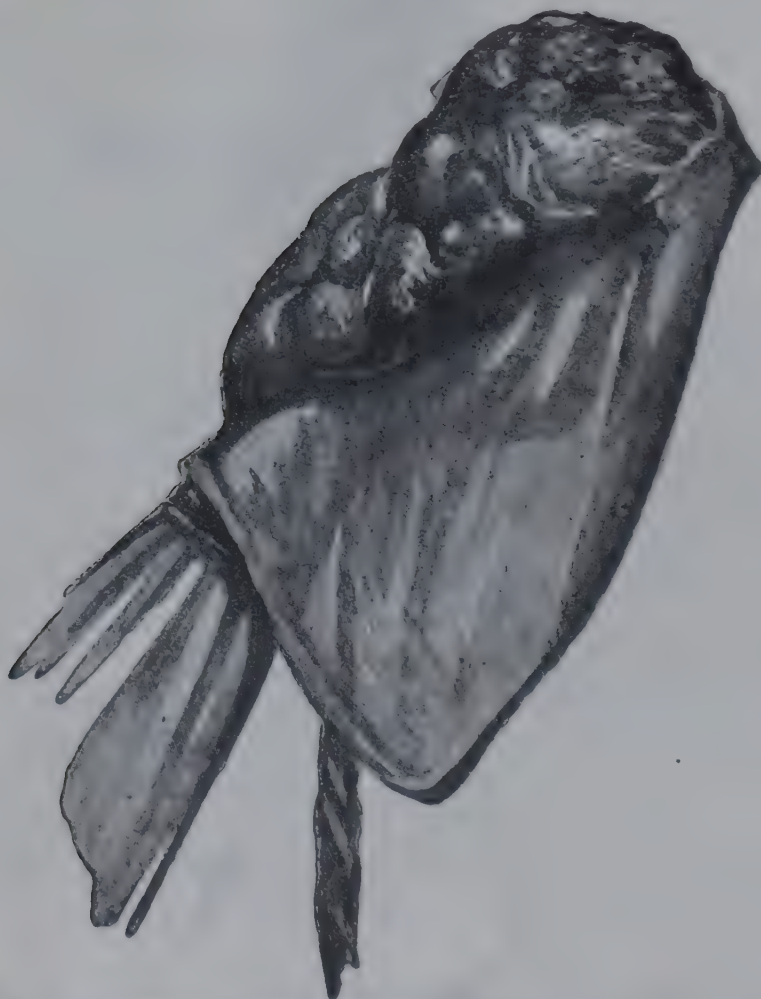


FIG. 54.—Examination of the placenta—maternal surface.

they are washed with water and the placenta and membranes carefully examined. The uterine surface of the placenta should

first be examined to see that the cotyledons lie in close apposition. There should be no defect on the uterine surface at the grooves between the cotyledons or at the margin of the placenta. The membranes are then examined carefully to see that both the amnion and the chorion are entire. Any small deficiency in the membranes should be carefully noted, as it may be due to the retention of a succenturiate lobe of the placenta.

Retained Placenta or Membranes. If portions of the placenta or the membranes are retained, the twin danger of hæmorrhage and sepsis may result. Any large bits of placenta should undoubtedly be removed immediately by careful intra-uterine manipulation. Where, however, there is some doubt whether a small bit of membrane or a small piece of placenta has been retained it is safe to adopt an expectant plan of treatment. In the majority of instances the piece of membrane or bit of placenta is passed in the lochia on the third or fourth day of the puerperium. On the other hand, an intra-uterine manipulation to remove this piece is bound to increase the risks of sepsis.

Repair of the Perineum. Lacerations of the vagina and perineum should now be carefully sutured as also any episiotomy.

After the completion of the third stage the external genitalia should be carefully cleansed with sterile water or with an antiseptic lotion—Dettol or any other suitable antiseptic. The cleansing should include the thighs, buttocks and the lower parts of the abdomen, since these are usually soiled by blood, etc. If there are abrasions or slight lacerations the parts may be touched with an antiseptic. A sterile or antiseptic pad of some absorbent material should be applied to the vulva and held in position by means of tapes attached thereto, which are tied at the waist, or fixed by safety-pins to the abdominal binder. The antiseptic pad should be changed as often as it becomes soiled—at least every four hours on the first two or three days. The patient may have an abdominal binder applied. This is of comfort to some and helps to keep the uterus compressed and the intestines from getting distended because of the sudden release of intra-abdominal pressure. The obstetrician should watch the patient for at least an hour after completion of the third stage, and only then if everything is satisfactory should he leave the place.

Care of the Baby. Once the patient has been made comfortable the care of the baby should be the next concern of the attending midwife. The baby should be given a bath after the body has been smeared with oil, preferably olive oil. The vernix caseosa can then be easily washed off. The baby should be examined care-

fully for evidence of congenital abnormalities particularly the genital organs and the anus. The cord should be carefully dressed again after the bath and a light dress put on.

The patient should be settled in bed two hours after delivery, if she has been on a delivery board, and kept in a well-ventilated room and protected from draughts. She should be allowed to have a comfortable sleep at this stage, after giving her some light nourishment. After the patient has rested for sometime, the baby should be put to the breast about six hours after delivery.

Before leaving the patient the obstetrician must make sure that the uterus is well retracted, there is no undue bleeding and the pulse is below 100 and slowing.

SECTION IV

PHYSIOLOGY OF THE PUERPERIUM

CHAPTER XIII

THE PHENOMENA OF THE NORMAL PUERPERIUM

THIS is the period which begins with the termination of the third stage of labour and lasts till the genital organs have assumed their normal condition again. It is no doubt true that once delivery has taken place the genitalia cannot return to the same condition as before pregnancy.

The normal duration of the puerperium is from six to eight weeks, although in its more restricted sense it covers the period of ten to fourteen days immediately after delivery, during which the more radical changes take place.

The changes that occur during this period are :—

- (1) Changes in the uterus.
- (2) Changes in the cervix, vagina and external genitalia.
- (3) Changes in the breasts.

Changes in the Uterus. The most striking feature about the puerperium is the change that takes place in the uterus. Immediately after delivery the uterus is hard, very much reduced in size and the fundus is generally felt about 10 to 12 cm. above the symphysis pubis. During the puerperium the uterus gradually diminishes in size, and by the tenth or twelfth day it can no longer

be felt by abdominal palpation. This process is known as *involution* of the uterus. The uterus never actually returns to the original state, and in a parous woman it always remains a little bigger and more freely movable than in a nullipara. The rate of involution of the uterus varies with different individuals, but should generally be progressive from the first day onwards. In certain cases, as in anæmic women, and in conditions associated with puerperal sepsis, involution of the uterus may be retarded. In some cases the uterus may be pushed to one side or the other and involution may be interfered with owing to collection of lochial discharge in the cavity.

The process of involution is effected by autolytic processes by which the protein material of the uterine wall is broken down into simpler components which are then absorbed and excreted in the urine. That this is so is proved by the increase in nitrogen excretion by 30 to 50 per cent which is noticed during the second or third day of the puerperium. The nitrogen excretion returns to normal by the time the uterus becomes a pelvic organ.

The greatly hypertrophied uterine vessels become obliterated by thrombosis immediately after delivery and later degenerate. Hyaline change completely obliterates the larger vessels and new and smaller vessels develop in their stead. Eventually the blood-clot in the lumen of the vessels becomes absorbed and the vessel walls are then represented by a solid or thinly canalised mass of hyaline tissue.

After delivery, the endometrial surface of the uterus is thick and rough especially over the placental site. Degenerating decidua, blood-clots and bits of fœtal membrane may be present in the uterus. Gradually these undergo degeneration and are generally cast off in the lochial discharge. After the greater part of the surface has been thus shed, regeneration takes place from the remains of the mucous membrane and from the epithelium of the deeper portions of the uterine glands. The process closely resembles that of the healing of a granulating surface on a mucous membrane. The regeneration generally begins in the first week after labour and is complete in about a month, except over the placental site.

During the puerperium a discharge is present, which is known as the *lochia*. It consists of blood and decidual membrane and occasional bits of fœtal membrane and clots. The lochia is generally red for the first three days, and later becomes pink, gradually becoming pale. It lasts for ten to twelve days and may return again after two or three weeks, when the patient begins to move about freely.

The *quantity* of the discharge varies with different individuals. Generally the number of diapers stained during the twenty-four hours

gives an approximate idea as to the quantity of lochia passed. In some pathological conditions, such as anæmia, the lochia may be very scanty. In cases of retroflexion of the puerperal uterus, the lochia may be retained and get decomposed. Occasionally, as in septicæmia, there may be supression of lochia. The lochia may, on the other hand, be increased in quantity in cases where there has been a large placental site, as in twins.

Other points to be noted about the lochia are its *colour, odour, quality* and *method of staining on the diaper*. The colour varies with the period of the puerperium, and as has been stated above, usually it is bright red for the first two or three days, pink for the next three days, gradually becoming pale subsequently. Ordinarily, healthy lochia has got a sweetish-mawkish odour, but if organisms have gained admission the smell may be very offensive.

By the *quality* of the lochia is meant its composition. In some cases where bits of membranes or placenta are left behind in the uterus they may be found in the lochial discharge. Not infrequently decomposing blood clots may also be expelled. If the tissues have been damaged, sloughs from the cervix or the vagina may be passed.

The *pattern of staining* on the diaper must be noted. Healthy lochia stains more deeply in the centre than at the edges; while if it is unhealthy and decomposing the edges are more deeply stained than the centre. In healthy lochia the deeper staining at the centre is due to the deposit of the heavier corpuscular element, while the serum exudes to the peripheral area and stains less deeply; in unhealthy lochia, on the other hand, the corpuscular element is decomposed and the edges tend to stain more deeply and so there is usually more uniform staining.

Changes in the Cervix, Vagina and External Genitalia. The cervix also participates in the general involution of the uterus and its canal gradually becomes smaller and smaller. The cervix, however, never returns to the non-gravid state, the external os of the cervix being always patulous in a multipara, while it is closed in a nullipara.

The vagina takes some time to recover from the distension to which it was subjected. The vaginal outlet is markedly relaxed and signs of laceration may be noted. The hymen completely disappears as such, and its place is taken by a number of small tags of tissue which cicatrise and are known as *carunculæ myrtiformes*. This is a characteristic sign of parity.

The perineum is also relaxed, the degree of which depends upon whether it has been lacerated or not during the process of delivery.

The pelvic floor is stretched during the process of delivery, and will be found relaxed. Gradually there is a regain of tone, but a certain amount of gaping of the vulva usually remains in a parous woman.

Changes in the Urinary Tract. Cystoscopic studies conducted soon after delivery show commonly œdema and hyperæmia of the bladder mucosa. At times the trigone is very œdematous. The puerperal bladder has a very much increased capacity and is relatively insensitive so that the bladder can be overdistended considerably without the patient complaining of pain. Overdistension and incomplete emptying are therefore common in the puerperium. The insensitivity of the bladder is due to trauma sustained by the nerve plexus during delivery and is a passing phase only. As a result of overdistension and presence of residual urine, infection of the urinary tract in the puerperium is common. The dilatation and tortuosity of the ureters which occur in pregnancy disappear completely in the puerperium within four to six weeks. There is pronounced diuresis on the second or third day of the puerperium.

Changes in the Abdominal Wall and Peritoneum. Synchronous with the changes that take place in the uterus and vagina, the pelvic peritoneum and the structures of the broad ligament accommodate themselves to the changed conditions. The *striæ gravidarum* do not disappear. As a result of the continued distension during pregnancy the abdominal wall remains flat and flabby for some time. A certain amount of this laxity and flabbiness will remain permanently unless proper exercises for the abdominal muscles are persevered with. Occasionally divarication of the recti muscles is met with, so that one can easily pass a hand in the median line between the two recti and palpate the abdominal contents. Here again proper exercise and massage will help to regain the tonus of these muscles.

Changes in the Breasts. After delivery, lactation is established in the breasts and the mother can nourish the child with breast milk. Unlike other mammals, milk is not secreted by the mother till the second or third day of the puerperium. For the first twenty-four hours and sometimes for forty-eight hours following delivery, a thin liquid is secreted from the breasts, which is known as *colostrum*. The breasts become larger, fuller, the veins become more prominent, and the patient has the feeling that the secretion of milk is beginning. If the child is put to the breasts regularly, the milk begins to be secreted gradually in increasing quantities. The colostrum that is secreted within the first twenty-four hours is of a deep yellow colour, alkaline in reaction, and if a drop of it is examined under the microscope, it will be found to consist of fat globules, a watery fluid and some corpuscles known as colostrum corpuscles. These corpuscles are

round, ovoid or stellate cells, which contain one or two nuclei. Colostrum contains very little, if any, casein, but a great proportion of lactalbumin and lactglobulin with much fat. It has a slight laxative action on the new-born baby and helps to clear the meconium from the intestines.

Physiology of Lactation. About the middle of pregnancy the alveolar cells in the mammary gland after completion of growth begin to show secretory activity. The increasing amount of œstrogen and progesterone produced by the placenta stimulates mammary growth, œstrogen tending to promote duct development and progesterone the alveolar system. It is believed that both these hormones inhibit the activity of the leutotrophic hormone from the anterior pituitary (LTH) which is now thought to be identical with prolactin. With the delivery of the placenta however this inhibition is removed and the prolactin is then free to initiate lactation.

The posterior lobe of the pituitary secretes a hormone oxytocin which stimulates the expression of milk. In animals it has been shown that this expression depends upon a reflex action initiated by suckling or nuzzling of the nipples of the breast of the mother by the young. This action carries afferent stimuli by nerve pathways to the brain. So stimulated the neurohypophysis liberates the hormone which then stimulates the mammary gland. This reflex may be inhibited by fright or any distressing stress. However it would appear from evidence available such as successful lactation in cases of diabetes insipidus, an intact posterior pituitary is not necessary for lactation in human beings.

The fluid portion of the milk is a transudate and consists of protein material, milk, sugar, salts and water. The protein in milk consists of one-third casein and two-thirds lactalbumin. They differ from serum albumin in that they do not coagulate on heating. In addition to fat and lactose or milk sugar, milk contains a considerable amount of mineral matter one half of which consists of calcium phosphate and potassium carbonate while the remainder is made up of sodium chloride and minute quantities of several other salts including iron. The average composition of milk is as follows :—

Protein 1 to 2 per cent, fats 3-5 per cent, sugar 6.5 to 8 per cent, salts 0.1 to 0.2 per cent, the rest being water.

The milk that is secreted after forty-eight hours differs from the colostrum. Human milk is an opaque, slightly yellowish liquid, with a sweetish taste and a characteristic odour, and is slightly alkaline in reaction. The specific gravity varies between 1025 and 1035.

The secretion is influenced by various factors, among which may be mentioned diet, hormones, mental emotions, and drugs. Emotions may alter the quality and quantity of milk. The milk gradually dries up if another pregnancy starts during lactation.

Certain drugs may be excreted through the milk and thus affect the infant. Prominent amongst these are cathartic purgatives, alcohol, opium, iron, arsenic, iodine, lead and mercury. Many factors may influence the volume of milk production. They include the age, parity and the state of health of the mother, as also the age and weight of the infant and there are also, in addition, individual variations. The techniques employed for measurement of milk yields have their drawbacks. It is estimated that a mature milk flow is about 850 ml. per day representing a net energy loss of about 600 k. calories to the mother.

CARE OF THE PUERPERIUM

THE care of a pregnant woman does not end with the delivery of the child and the conclusion of the third stage. In fact, both for the immediate and the ultimate prognosis, a good deal of care is required during the puerperium if the patient is to escape the immediate risks and, at the same time, not predispose herself to many of the remote gynaecological troubles associated with neglect during the puerperium.

Following a normal delivery the patient should be visited daily for a week or ten days. At each visit the general condition of the patient, temperature, pulse, lochia, involution of the uterus, the perineum in those with sutures, the state of the bladder and bowel should all be observed.

Early ambulation. Important changes have taken place in the management of the puerperium in the direction of early ambulation. It is now the general custom to allow normal patients out of bed within the first 48 hours postpartum. The many advantages of early ambulation are confirmed by numerous well controlled studies. Patients state they feel better and stronger after early ambulation. Bladder complications leading to catheterization as well as constipation are less frequent. The objections to early ambulation namely delayed involution, improper healing of episiotomy wounds, increase in the incidence of genital prolapse are now considered as more theoretical than real.

After-pains. In some cases the patient complains of very severe pains, which may be more painful than labour pains. After-pains are more likely to occur in multiparæ, in women who have had a precipitate labour, and in primiparæ where the uterus was over-distended, and in cases where clots have been left inside the uterus. Analgesics relieve the pain.

Temperature. The normal puerperium should be apyrexial. The temperature should be recorded at intervals of every four hours and any rise above 100° should be specially noted. It is not infrequent for a slight rise of temperature to be present within the first twenty-four hours after delivery; occasionally the woman may even get a chill with rigor and the temperature may shoot up to 101° to 102° . Generally, however, within twenty-four hours the temperature comes back to normal and keeps normal. Any rise of temperature thereafter must be viewed with suspicion, and it should be presumed that every

such rise is due to infection, uterine or urinary, unless these can be satisfactorily eliminated and other causes of pyrexia identified.

Pulse. A rise in the pulse-rate is a more sensitive index of abnormality than even the temperature. If the pulse-rate is above 90, the attention of the physician should be drawn to it. The relation between the pulse and the temperature is a factor to be taken into consideration. In severe cases of uterine sepsis, the increase in the pulse-rate will be found to be out of proportion to the rise in temperature.

Diet. The old idea that a very limited diet should be given to the puerperal woman and that it should largely consist of liquid diet is no longer held. Immediately after delivery, and probably for the first forty-eight hours, the patient is not inclined to eat much; but after this period, the appetite is good. The diet should be fairly liberal and of a varied nature. Plenty of proteins, meat, fish and fresh fruit, green vegetables, tomatoes and salads may be given. The total diet should have an additional 1000 calories to cover the energy requirements of lactation.

Involution of the Uterus. The uterus gradually involutes during the puerperium. Immediately after labour, the fundus of the uterus is at the level of umbilicus or one or two fingers below. Occasionally the uterus may be displaced to one side or the other—more often to the right, in which case it is well to bring it to the median line and then ascertain the height of the fundus above the symphysis pubis. The most important thing to note in the puerperium is the rate of involution of the uterus. Sometimes, on the second or third day, the uterus may not be palpable abdominally. This should at once arouse suspicion of the possibility of a backward displacement of the puerperal uterus. The height of the uterus should be noted on each day and should be charted to observe the progressive rate of involution. Before ascertaining the height of the uterus the bladder must be empty. A distended bladder will push it up. In normal cases the level of the fundus will be found to descend a finger's breadth with each day of the puerperium, and by the tenth or twelfth day, it should be a pelvic organ once more.

The Lochia. At each visit the obstetrician should carefully examine the lochia. The quantity, quality, odour, the method of staining on the diaper and the presence of any abnormality in the discharge should be noted. The lochia is generally known as lochia rubra, lochia serosa, and lochia alba, depending upon the colour. Usually for the first three days it is red, and is called *lochia rubra*; for the next three days it is more sero-sanguineous, and is called *lochia serosa*; while after that it tends to become pale and is called *lochia alba*.

The lochia may occasionally be brown or even dark as a result of decomposition. The smell of the lochia is said to be sweetish-mawkish, and any variation in the odour should arouse suspicion of sepsis.

Complete suppression of the lochial discharge may be due either to retention, or to suppression as in cases of septicæmia. During the puerperium the diaper should be frequently changed, particularly if the lochia is abundant and offensive, and the parts well washed and protected whenever the diapers are changed.

Bowels and Bladder. It is usual for the patient who has been healthy and moving about to be constipated when she suddenly takes to bed after delivery. Laxatives may be given to promote bowel movement. The genitalia should be cleaned and protected after every evacuation of the bowels.

Every effort should be made to induce the patient to pass urine within 6 to 8 hours of delivery. If she is unable to empty her bladder, it is safer and better to catheterise the bladder, after due aseptic precautions. It may be necessary to repeat this process every 8 hours for the first day or two. In cases where the bladder does not empty even after this period, a retention catheter may have to be used for a few days. Wherever possible catheterisation is best avoided.

Breasts. Care of the breasts must begin from the later weeks of pregnancy. If sufficient care has been taken to keep the breasts clean and have the nipples drawn out, touched with spirit and protected, no trouble should arise during the puerperium. Once the baby has arrived, the nipples should be washed with boric lotion and dried before and after each feed. The child should be put to the breast at regular intervals, generally every three hours, between the hours of 6 a.m. and 10 p.m. If cracks and abrasions be present the parts should be well cleaned, and the child breast-fed with the help of a nipple-shield. It is important to make every mother realise the need for breast feeding in the interests of the baby. In the early days of the puerperium it also helps to promote involution of the uterus. Breast milk probably contains some of those antibodies that are essential in the early days to protect the child from infections. The fact that she is nursing the baby has got a good moral effect upon the mother who will take better care of her health and habits.

In cases of syphilitic children the mother is the only person that ought to nurse. In puerperal sepsis or certain general constitutional diseases, such as tuberculosis, anæmia, etc., it may be necessary temporarily to wean the child from the mother. The method of feeding under such circumstances will be discussed elsewhere.

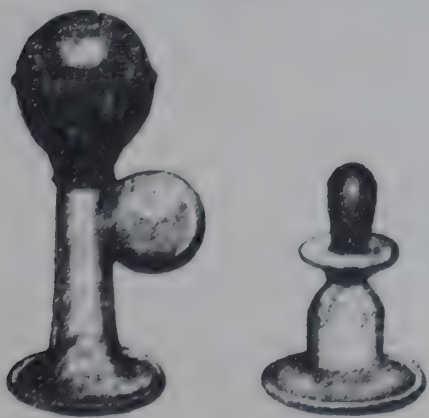


FIG. 55.—Breast reliever and the nipple-shield.

Care of the Perineum. In all cases where lacerations of the perineum have occurred during labour, the necessity for

immediate suture has been emphasised. This lessens the chances of puerperal infection. The re-formation of the pelvic floor serves to preserve its tonus, so that the tendency for prolapse at a later date is diminished. In cases where the perineum has been sutured, it should be kept clean and dry. The perineum should be attended to morning and evening and after each urination or defecation. Where a complete perineal tear has been repaired a non-residual diet should be given to the patient for four to five days. Laxatives should then be given to permit of a soft motion. Usually the stitches may be removed from fifth to seventh day. If the stitches tend to cut through, they should be removed earlier. If the perineum has not healed satisfactorily, the patient is advised to seek further treatment at the end of the third month after delivery. There is general agreement on the importance of systematic exercises in the puerperium. The purpose of these postnatal exercises is mainly to restore the tone of the abdominal and pelvic floor muscles.

Postnatal Care

The normal patient who is having no difficulties during the puerperium should return for examination at the end of the sixth week of the puerperium. Postnatal clinics are better organised in connection with child welfare clinics where the mother can be seen at the same time as the baby. It is better still if this can be combined with a family planning clinic. At this time her general physical condition should be checked, the blood pressure taken, urine examined for protein, the condition of the abdominal wall noted, the breasts inspected and a thorough pelvic examination carried out. Such abnormalities as cervicitis can be treated at this time and arrangements made for further treatment or examination when indicated. Contraceptive advice should be given to all mothers.

The common complications which are likely to be met with are cervicitis, minor degrees of cystocele and prolapse, retroversion of the uterus and inflammatory lesions of the adnexa. These should be attended to without fail as major gynæcological problems can then be prevented to a great extent.

Cervicitis. There can be no doubt that lacerations and infections of the cervix often give rise to a minor degree of discomfort and disability. Cervicitis is well recognised as a cause of leucorrhœa and backache. Acting as an infective focus it also gives rise to arthritis, rheumatism, etc. Cervical lacerations and erosions are also predisposing causes of cancer of the cervix. The necessity for early recognition and treatment is therefore evident.

When cervicitis is found at this post-natal examination, it should be treated preferably by electric cauterization. Three to four radial incisions with the cauterization $\frac{1}{4}$ to $\frac{1}{8}$ inch deep on each lip of the cervix should be sufficient. No anæsthesia is ordinarily required for this purpose. The patient should be asked to return eight weeks later to gauge the extent of healing and for further treatment if necessary.

Retroversion of the Uterus. This is often found at the post-natal examination. If there are no symptoms attributable to it, the retroversion may be left alone. If, however, it is associated with backache and sub-involution, it should be replaced and kept in position by a Hodge pessary. The pessary should be retained for two months during which period cleansing douches will be necessary.

Prolapse. Slight degrees of cystocele and rectocele, if met with, can be cured by exercises designed to strengthen the pelvic floor. Should, however, the prolapse be marked, effective cure can be obtained only by operation at a later date.

Inflammatory lesions of the adnexa. Inflammatory lesions of the uterus and adnexa and the pelvic cellular tissue may occasionally be encountered. In such condition, the patient complains of a constant backache, chiefly over the sacral region, and is relieved by lying down. Pain in the right and left iliac fossæ and hypogastrium is also associated with it. Bimanual examination will reveal the swelling at the side of or behind the uterus.

Treatment consists of rest, and adequate treatment of the anæmia which is commonly present. Antibiotics to combat the infection and ultra short-wave therapy to the pelvis will help to resolve the inflammation.

Backache. This is very commonly encountered after parturition. The common causes are (1) cervicitis (2) retroversion (3) prolapse (4) pelvic inflammation (5) functional muscular insufficiency and (6) pelvic arthropathy.

Treatment of the causative lesion usually cures the condition. Muscular insufficiency often occurs after parturition. During the last weeks of pregnancy there is more or less lordosis. When normal posture is resumed after delivery, there is at times a temporary failure of re-adjustment of muscular action, especially of the Latissimus dorsi and Sacrospinalis muscles. Especially in women with poor health and who have to do heavy household duties, the muscles are easily fatigued. The usual symptoms are aching pain in dorsi lumbar region, accompanied by a feeling of fatigue and tenderness over the muscles. At first the pain is relieved by rest but later it becomes constant. The

pain radiates to the thigh. Treatment consists in improvement of general health, adequate rest, general tonics and iron for anæmia. Physiotherapy, in the form of massage and graduated exercises, is helpful.

Pelvic Arthropathy. There is, in normal pregnancy, softening and relaxation of the joints of the pelvis. This may sometimes be excessive and give rise to pain over the symphysis pubis and one or both sacro iliac joints. The condition is aggravated by walking and relieved by rest.

After delivery the condition subsides rapidly. Persistent back-ache may result from this condition. Manipulation under anæsthesia and wearing of a supporting corset for two to three months help in the cure of this condition.

Maternal Palsies. The lumbosacral cord may be bruised at the brim of the pelvis by the fœtal head during labour. This is more so in cases of prolonged labour due to disproportion and instrumental delivery. It may also occur in spontaneous labour. As a result, in the post-natal period there is found unilateral paralysis of the lower extremity. All the muscles and skin areas supplied by the lumbosacral cord may be affected but those supplied by nerves arising from the fourth and fifth lumbar and first and second sacral trunks are the most frequently involved. These muscles are the extensors of the foot and toes and the evertors of the foot. There is anæsthesia over the skin of the lower part of the leg, the ankle, and the foot. The symptoms usually noticed soon after delivery are numbness and weakness of one or both lower extremities. In a day or two foot-drop develops and there is inability to evert the foot. Ankle jerks may be absent. Both sides may be involved. Treatment consists in keeping the foot dorsiflexed by a splint to prevent over-stretching of the muscles. Gentle massage and passive and active movements are helpful.

All patients after confinement must be given definite dates to attend the postnatal clinic.

CARE OF THE NEW-BORN CHILD

THE sudden transition from the protected environment of intra-uterine life to the risks of extra-uterine existence is beset with certain dangers to the new-born child. Care is required, therefore, till it becomes acclimatised to its new surroundings and to the new methods of existence. The new-born child has now to undertake for itself the functions of digestion, respiration, excretion and maintenance of the general body warmth and the satisfactory establishment of these involves the observance of certain physiological principles.

Care Immediately After Delivery

As already described, immediately after delivery one must ensure that the child breathes and cries out, that the umbilical cord is properly ligated and severed. The child is then wrapped in a warm towel or blanket and placed in the cradle till the third stage of labour is over. Thereafter the child should be examined in detail for any abnormalities. It should then be properly cleaned. The body is covered with blood and vernix caseosa, and to remove these it is best to smear it with warm oil, such as olive oil or albolin, which dissolves the vernix. Then the body is wiped with a soft towel. In the tropics it is preferable to give the child a warm bath. The cut end of the umbilical cord should be cleaned with an antiseptic solution and touched with Tincture Benzoin or Iodine or Spirit. Sterile dressing is then applied with a small bandage round the abdomen to keep it in position. The dressing is changed daily and the cord dressed with spirit.

Care of the Eyes. As soon as the head is born, and before the child can open its eyes, the lids should be swabbed with pledgets of cotton-wool soaked in boric lotion or normal saline—a fresh pledget should be used for each eye. The eyelids should then be properly opened so that a drop of one per cent solution of silver nitrate or penicillin ophthalmic ointment is instilled into each eye as a prophylactic against gonorrhœal ophthalmia. The eyes are again washed with saline solution. It is wise to take this precaution for all infants born in institutions. In private practice, unless the obstetrician is sure that there is no possibility of gonococcal infection, it is wise to apply penicillin ophthalmic ointment. In many clinics, instead of silver nitrate, penicillin eye ointment is used. Should gonorrhœal ophthalmia

develop which is diagnosed by examining smears for the presence of gonococci, penicillin, 60,000 to 300,000 units should be administered intramuscularly.

Bowels. During the first two or three days, the stools consist of meconium, which is a greenish-black semi-solid substance with a great deal of bile pigment in it. Faeces begin to appear on the third day after delivery. During the first two days the colostrum that the baby gets from the mother's breast has a laxative effect and enables the meconium to be expelled. Ordinarily, the number of motions per day should be limited to three or four, and they should be of a soft consistency and yellowish in colour. Change in the colour or frequency of the stools is a sign of gastro-intestinal upset. The anal region should be properly cleaned and protected. Frequent changing of the napkin, the use of dusting powders and the avoidance of any rough cloth for cleaning the anal region are essential to prevent excoriation of the buttocks.

Micturition. The infant should micturate within the first twelve hours : if not, the parts should be examined to see if any congenital deformity exists. In the male a tight prepuce or congenital phimosis may be the cause. Occasionally the meatus may not be patent, and it is necessary to pass a sterile probe to open it.

Care of the Umbilical Cord. The umbilical cord, which has been dressed soon after birth, should be attended to every day. The binder should be changed whenever it becomes soiled and the dressings of the cord should be renewed daily. Usually the cord dries up and separates on the seventh or eighth day. Occasionally there may be some sign of inflammation. The cord must be allowed to drop off by itself and no attempt made to hasten separation by pulling on it.

The Weight of the Child. During the first four days the infant loses weight, on an average about 0.1 kg. for a normal baby weighing 2.8 kg. A more rapid loss of weight is suggestive of some pathological condition. Breast-fed infants lose less than infants fed artificially. After the first four days the infant should gradually gain weight. An excessive gain in weight in a short time is suggestive of some defect in feeding, such as overfeeding. Premature infants lose more weight relatively and are slow to regain it. The weight is perhaps the best index of the progress of the infant. The baby should be weighed at intervals of one or two weeks. The weight should be charted so that a graphic record may be available for ready reference.

Clothing. Warm yet light clothing should be used. The extremities should be fairly free for movements. A napkin should be applied and changed frequently.

Bath. The child should be given a bath daily. This is certainly of importance in tropical countries. After the daily bath it is advisable to use a dusting powder, especially about the groins and the axillæ and the neck, to keep the parts dry and clean. It is useful to smear oil over the whole body before giving the child a warm bath.

Breast-Feeding

The most appropriate food for the baby is mother's milk, and breast-feeding should be insisted upon. Six hours after birth the child is put to the breast. The advantage of this is twofold. Apart from the maternal instincts being thereby satisfied, the sucking by the child at the breast promotes better involution of the uterus and the colostrum ingested by the baby has a light laxative effect. Before and after the child is put to the breast, it is necessary to clean the nipples. The time to be taken for each feed depends upon the ease and speed with which the child gets the required amount of milk. It should be put to the breast at intervals of three or four hours, except during the night, for the first forty-eight hours, and preferably the breasts should be used alternately. The nursing may last from ten to twenty minutes. The advantages of breast-feeding are: (1) mother's milk is best adapted to the digestive capacities of the child, (2) the milk is sterile, (3) it is a perfect food and supplies all the vitamins that are necessary, (4) it confers some degree of immunity to infections.

After the first forty-eight hours the child should be put to the breast at regular but more frequent intervals, generally of three hours, between 6 a.m. and 10 p.m., with, if necessary, one feed in the night.

Contra-indications for Breast-Feeding. Under some circumstances breast-feeding is contra-indicated.

(1) Maternal diseases, such as tuberculosis, cardiac disease, acute illnesses, or contagious diseases, severe grades of anæmia, severe puerperal sepsis, puerperal psychosis.

(2) Local conditions preventing breast-feeding; fissures of the nipple, acute mastitis, abscess of the breast, defects of the nipple such as incurable retraction.

Syphilis in the mother is not a contra-indication to nursing. Indeed the syphilitic child stands in greater need of breast milk than a healthy child, and as both the mother and the child are infected there is no increased risk.

Sometimes breast milk may not agree with the child, or may not prove sufficient. Deficiency in the quality and quantity of the milk may be due to several causes. Among these may be mentioned : (1) general ill-health of the mother, (2) grave nutritional disturbances and dietetic deficiencies, (3) defective development of the breasts, (4) worry and mental emotions on the part of the mother, or severe physical strain and exhaustion.

If breast-feeding is contra-indicated or unsatisfactory, artificial feeding with any of the various proprietary milk foods prepared according to correct formulæ should be resorted to.

Suppression of lactation

When the baby is dead born or dies in the neonatal period or when breast feeding is contraindicated it becomes necessary to suppress lactation. In many, if lactation is not suppressed troublesome breast engorgement, pain and leakage of milk occur. Oestrogens are known to relieve these symptoms and a usual routine is to give stilboestrol 5 mgm. t.d.s. for four days followed by 5 mgm. b.d. for two days. Often there is rapid alleviation of symptoms. A mixture of 10 mgm. of oestradiol and 200 mg. of testosterone in an oily base given as one injection at the time of the birth of the child is stated to be very effective in suppressing lactation in 80% of cases.

SECTION V

PATHOLOGY OF PREGNANCY

CHAPTER XVI

HYPEREMESIS GRAVIDARUM

PREGNANCY is essentially a physiological process. But in a certain number depending upon the antenatal care taken complications may arise. Some of these complications are specific to pregnancy, while other conditions which occur in the non-pregnant state can complicate the pregnancy. The diseases peculiar to pregnancy are classed under the heading 'Toxæmias of Pregnancy' though in this group also are included certain diseases which are not peculiar to pregnancy. This inclusion is necessitated because of the similarity of their clinical manifestation.

In this section the toxæmias of pregnancy and some only of the diseases complicating pregnancy are discussed.

For long, nausea and vomiting of pregnancy and acute hepatic necrosis or acute yellow atrophy were classified under toxæmias of pregnancy. They are now no longer considered as toxæmias of pregnancy.

Vomiting in the early weeks of pregnancy is very common. But if it is mild, its frequency being just once or twice in the morning, the quantity small and seldom does it tell on the patient's health. She is able to retain enough food and does not lose weight appreciably. Sometimes however the vomiting persists, increases in frequency, very little nourishment is retained and she loses weight. To this

excessive vomiting in pregnancy the term hyperemesis gravidarum is applied.

Ætiology. Excessive vomiting in pregnancy is more common in the primigravida than in the multipara. It may sometimes repeat itself in successive pregnancies. The vomiting usually starts early in pregnancy about the sixth or eighth week—in fact sometimes it may be one of the earliest symptoms leading to a suspicion of pregnancy. In most cases the vomiting passes off by the 12th week, though in some it may persist on to the second trimester.

The exact cause of this vomiting is still uncertain. Various theories have been put forth but few are convincing. So far no toxin has been demonstrated to which vomiting can be attributed. It is customary to talk of

1. Toxic, and
2. Neurotic factors.

Pregnancy induces even in the early weeks profound physiological changes in the system. The major biochemical changes that take place in the system, as a result of pregnancy, induce vomiting which disappears in a short while in most cases, as the system rapidly adapts itself to these changes. However, in some the vomiting persists. Apparently, in pregnancy even in the early weeks there is an impaired carbohydrate reserve. When vomiting occurs with its accompanying starvation, the body's carbohydrate store is used up for its immediate needs. When the carbohydrate store is depleted, the fat stores are utilised, which being incompletely oxidised give rise to ketosis and the symptoms of toxic manifestation that follow. Many believe that almost all cases of hyperemesis have a neurotic basis. This theory has been substantiated to a great extent because of the rapid improvement in these patients when they are removed from their surroundings and isolated in an institution. Various psychogenic factors have been considered. Whatever it may be due to—whether the underlying factor is a neurosis or not—if the patient is left neglected and without sufficient nourishment being retained, the final outcome is that of a toxic type of vomiting, with depleted carbohydrate stores and ketosis. Simple treatment of the neurotic factor alone without taking steps to correct the salt, water and carbohydrate balance will not save the patient. On the other hand a combination of both is almost always successful.

Hormonal imbalance occurring in early pregnancy is said to be an ætiological factor. Lack of progesterone and excessive amounts of chorionic gonadotrophic hormone are favoured by some as the causative factors. The evidence is conflicting and not convincing.

It has also been suggested that hyperemesis is an allergic reaction and hence the success claimed in treatment with antihistamines. In the present stage of knowledge all that can be said is that perhaps hyperemesis is the result of failure on the part of the system to rapidly adjust itself to the profound biochemical changes that take place in pregnancy, and in those with neurotic background the adjustment is more likely to fail than in others. Hence hyperemesis is more common in such patients.

The Pathology. Sheehan has demonstrated that the lesions found in the vital organs of persons dying from hyperemesis are identical with those found in patients dying of chronic malnutrition.

The body is very badly emaciated and dry with every evidence of dehydration. The liver shows marked changes. It is shrunk and small in size. The histological picture is one of fatty infiltration, the distribution being centrilobular. Sheehan believes that the so-called central necrosis is not common. The heart is usually small and sub-endocardial hæmorrhages could be seen. The kidneys may show fatty degeneration in the convoluted tubules and sometimes evidence of toxic nephrosis. The brain and central nervous system show changes suggestive of Wernick's encephalopathy and areas of punctate hæmorrhages in the grey matter, the third ventricle and in the floor of the fourth ventricle. All these changes have also been observed in patients dying of chronic malnutrition.

Clinical Course of the Disease.—The usual morning sickness so common in early pregnancy produces no ill effects on the patient. Usually she has a vomit or two as soon as she gets up from bed, there may be some nausea and distaste for food. These are soon overcome and no further troubles occur. But in some the vomiting, nausea and distaste for food gradually increases, the amount of nourishment taken in and retained becomes insufficient and this slow starvation begins to give rise to deterioration of her health. The patient begins to lose weight and the skin loses its elasticity. She finds it difficult to attend to her household duties and gradually she is forced to take to bed. The disease is insidious and when fully developed presents a characteristic picture. The patient is emaciated, eyes are sunken, skin is inelastic and dry, the conjunctivæ may have an icteric tinge, the tongue is dry and furred, the lips cracked and the breath smells of acetone. Abdomen is scaphoid, there may be tenderness in the epigastrium, the uterus may be palpable per abdomen. The vomit may be coffee-coloured. Mentally the patient is normal until the last stage when she becomes disorientated and a muttering delirium sets in. The retina may show hæmorrhages and signs of retrobulbar neuritis. At this stage there may be a total cessation of vomiting

which sometimes may be mistaken for improvement. The urine is considerably reduced in quantity, its specific gravity is raised and it contains large amounts of acetone and albumin, sometimes bile salts and pigments and Leucine and Tyrosine crystals. In severe cases chlorides are absent. Jaundice may set in.

The pulse becomes thready and rapid; blood pressure begins to drop; the temperature may become subnormal and ultimately the patient becomes comatose and dies. Rarely does spontaneous abortion occur in these cases.

The Biochemical Changes in Blood. The changes seen are those of electrolyte imbalance. The constant vomiting leads to loss of water and salt giving rise to hæmo-concentration and a fall in plasma sodium and chloride. The urine may even be chloride-free. There is marked degree of acidosis. The blood urea is raised.

The Diagnosis. It has to be borne in mind that a pregnant woman may develop excessive vomiting due to associated causes not connected with pregnancy, namely infections, cerebral and meningeal lesions, gastro-intestinal diseases, and the like. These could be excluded by the history and investigations. Abdominal pain characteristic of conditions like acute appendicitis are usually absent. In vesicular mole, in twin pregnancy with acute hydramnios there may be severe vomiting. Sub-acute or acute Pyelitis is found often in association with vomiting in pregnancy.

The Treatment. Exaggerated morning sickness can be treated by reassurance and simple dietetic regulations. The patients should be assured that it is not at all abnormal to have some vomiting in early pregnancy. She should be advised to take small and frequent feeds instead of large ones at long intervals. Fatty and rich food is better avoided. Food should be largely composed of carbohydrates, fruits and vegetables. Toasts, biscuits, jam and jelly are recommended. Sticks of barley sugar provide a palatable medium of easily assimilable glucose. Bowels should be kept regularly open. No purgatives need be given. Laxatives to prevent constipation may be all that is required. A large number of medicines has been recommended as specific for this condition. If medicines are effective it is due largely to a psychic effect. Antihistamines have come to play a large part in recent years on the basis of a suggestion that hyperemesis is an allergic manifestation. Chlorpromazine and other antihistamine drugs have been used with success. But then the same success rate is obtainable by simple adjustment of diet and reassurance. Cure of vomiting by correction of a retrodisplaced gravid uterus or cauterisation of a cervical erosion is mainly due to the effect of suggestion.

Most cases respond easily to the above regimen. There may however be some who get worse. If, in spite of dietetic regimen and reassurance, the patient continues to vomit and signs of dehydration are apparent, she must be treated as a severe case.

Severe Cases. Such patients are best treated in institutions away from their homes and relations. The sudden improvement seen in some cases on such a change of environment is surprising. The patient should be kept completely at rest in bed. All feeding by mouth must be stopped for at least 24-48 hours. The lower bowels must be evacuated by an enema. The temperature and pulse must be recorded every four hours. A fluid balance chart should be maintained. This chart must show the amount of fluid administered, the quantity of urine passed and the amount of vomit. The blood pressure must be recorded twice daily. The urine must be examined for albumin, acetone, bile pigments and bile salts daily. In most cases of severe type, acetone will be present in large amounts in the urine. It is wise to test the urine for chlorides, as in some cases of excessive vomiting, chlorides may be diminished in quantity or even absent. The latter is a grave sign.

The aim in the management is to correct the electrolyte balance and supply the body with easily assimilable carbohydrate in the form of glucose in sufficient quantities to replace the depleted glycogen store and to correct the acidosis. The rectal administration of 5-10% glucose saline 6-8 pints a day is a useful procedure. It is however better in the very severe cases to administer 5% glucose saline intravenously as a continuous drip—4 to 5 pints in 24 hours will be the minimum required. Sedatives are helpful. If rectal glucose saline is being given, 30-60 grains of bromides can be added to it. Otherwise any of the ordinary sedatives can be used. Chlorpromazine 25 mgm. intramuscularly is particularly useful as it has got a beneficial effect. There are no specific drugs for the cure of this condition. Because of the nature of the pathological lesions found in the fatal cases it is advisable to give these cases 100 mgm. of aneurine hydrochloride by injection as also 20 ml. of 10% calcium gluconate intravenously daily in the acute phase of the disease. With this simple line of treatment, marked improvement sets in most of the cases within 24-48 hours. This clinical improvement in the patient's condition is associated with increased urinary output, a fast disappearing acetonuria and a steady normal pulse rate. It is possible in a large number to start the patients on feeding by mouth within 2-3 days. A start should be made with small quantities of fluids at frequent intervals, and within a few days the patient could be brought back to the regimen of solid diet.

The Prognosis. While in most cases the vomiting is easily controlled, in some the disease takes a more severe turn. The signs of

bad prognosis in those not responding to treatment are diminishing urinary output, persistent acetonuria, presence of albumin and bile pigments in urine, appearance of jaundice, coffee ground vomit and rising pulse rate with a fall in blood pressure. Ocular palsies and dimness of vision indicating nervous system involvement are particularly bad signs. The only treatment that may save the patient is termination of pregnancy. In cases of early pregnancy, it can be terminated by dilatation of the cervix and evacuation, but sometimes, particularly in primigravidæ, abdominal hysterotomy may be indicated. Local anæsthesia is safer than any other anæsthetic for these operations.

It must be borne in mind that termination of pregnancy should not be postponed till too late. If it is resorted to at such a stage in the disease when irreversible changes have occurred in the vital organs, termination will not help. It is, therefore, imperative that the patient be watched carefully and pregnancy terminated at the optimum time, if the patient is not responding satisfactorily.

ACUTE HEPATIC NECROSIS— ACUTE HEPATITIS IN PREGNANCY

UNTIL recently acute hepatic necrosis was believed to be due to a specific toxin and regarded as a toxæmia of pregnancy as most cases had occurred in pregnant women. It is now known that this disease is not peculiar to pregnancy and that hepatitis in pregnancy is due to well known causes affecting the liver.

It is customary to talk of toxipathic and trophopathic hepatitis. The former is due to the direct action of a toxic agent on the liver cells, e.g., chemical poisons like chloroform, carbon tetrachloride, virus infection as in infective hepatitis. The trophopathic variety is due to deprivation directly or indirectly of certain amino acids essential to cell life. The liver is more liable to be damaged by a toxic agent if it is rendered vulnerable by a deficiency of essential amino acids.

Toxipathic Hepatitis. In this group, infective hepatitis in pregnancy is the more common though occasional cases are encountered due to administration of carbon tetrachloride in the treatment of ankylostomiasis. The discarding of chloroform as an anæsthetic agent has eliminated the toxic hepatitis resulting from it in pregnancy. Infective hepatitis is due to a filtrable virus and it often occurs in epidemics. It is more common in pregnant women of the poorer classes living in crowded unhygienic surroundings. Their malnutrition renders the liver particularly vulnerable and therefore hepatic necrosis is more common in them.

It may occur at any period in pregnancy. The disease usually runs a more virulent course in pregnancy, especially when it occurs in the later weeks. The onset is insidious; anorexia, nausea, vomiting, and low fever may precede the onset of jaundice. Sometimes the first symptom noticed by the patient is the highly coloured urine. Once the disease is established the characteristic picture is seen—jaundice of varying grades, an enlarged tender liver in the early stages; urine shows bile pigments and bile salts, and liver function tests show impaired function. Blood urea is usually within normal limits. In the majority of cases the disease responds to symptomatic treatment, though it is slow. In about 30% of cases, especially in those with malnutrition and in epidemics, the disease takes a more serious turn and progresses to hepatic necrosis. Such patients are intensely jaundiced, there may be a low grade fever; epigastric pain and vomit-

ing are often present. The vomit at times is coffee ground. Liver dullness may be diminished and urine very heavily stained with bile pigments. These patients then pass into a low muttering delirium and coma from which they seldom recover. It is not uncommon to see some of these patients with intense jaundice, with no other symptoms, suddenly go into coma during pregnancy. Premature labour may set in at the height of the disease and post-partum hæmorrhage is quite common in these cases. Afibrinogenæmia may occur in a few of these cases. The mortality is very high.

Treatment. This is usually symptomatic. Calcium gluconate 20 ml. of 10% solution with 10-20% dextrose 1000 ml. in 24 hours is given intravenously as a routine. Thiamine hydrochloride 100 mgm. and 150 mgm. of nicotinamide are also given intravenously. Based on the ætiology of virus infection, tetracycline intravenously 500 mgm. daily has been advocated. Hydrocortisone 100 mgm. may be given intravenously or intramuscularly every six hours. At times these patients become very restless and even maniacal. Heavy sedation will have to be employed in such cases. If the patient survives and the general condition improves, oral feeding may be started with caution—fluids, vitamins and carbohydrates. From the obstetric point of view there is no indication to terminate pregnancy. If spontaneous termination occurs, post-partum hæmorrhage will have to be contended with. Blood transfusion will most often be necessary. The mortality in these cases, especially when it occurs in the ill-nourished woman, has been very high.

Obstetric Acute Yellow Atrophy. It is now believed that there is a type of yellow atrophy of the liver peculiar to pregnancy. The disease is highly fatal although rare cases with recovery have been reported. The characteristic pathological change is infiltration of all the hepatic cells by fine fatty droplets without the necrosis that characterises viral hepatitis.

TOXÆMIAS OF PREGNANCY

UNDER the term 'toxæmias of pregnancy' is included a heterogenous collection of diseases which may or may not be peculiar to pregnancy. The signs and symptoms of the toxæmias are nonspecific and in the present empiric state of our knowledge together with the fact that the pre-pregnant status of the woman is most often unknown makes accurate classification very difficult. The widely used classification is that of the American Committee on Maternal Welfare which is given below :

- I. Acute toxæmia of pregnancy (onset after the twenty-fourth week):
 - A. Pre-Eclampsia—
 1. Mild.
 2. Severe.
 - B. Eclampsia (convulsions or coma or both when associated with hypertension, albuminuria or œdema).
- II. Chronic hypertensive (vascular) disease with pregnancy:
 - A. Without superimposed acute toxæmia (no exacerbation of hypertension or development of albuminuria):
 1. Hypertension known to have antedated pregnancy.
 2. Hypertension observed in pregnancy (before twenty-fourth week and with post-partum persistence).
- III. Unclassified toxæmia (data insufficient to differentiate the diagnosis).

Pre-eclamptic Toxæmia and Eclampsia.

These two are by far the most important, common and true forms of toxæmia of pregnancy. Pre-eclamptic toxæmia may be defined as a condition occurring in the pregnant woman characterised chiefly by a rise in blood pressure, œdema and albuminuria and if neglected often ending in convulsions—eclampsia.

Incidence. This varies from clinic to clinic depending on the definition accepted. Taking a blood pressure of 140/90 mm. of Hg.

as high blood pressure the incidence at the Government Hospital for Women and Children among 1,50,662 deliveries was 8.4%. It fluctuates from year to year between 7% and 9%.

Ætiology. Certain factors predispose to the onset of pre-eclampsia. They are :

- (1) This toxæmia occurs chiefly in primigravida (70%).
- (2) It is more frequent in conditions associated with over-distension of the uterus and increased intra-abdominal pressure—Hydramnios and multiple pregnancy.
- (3) Diseases like diabetes, and hypertension in the mother, pre-dispose to the onset of the toxæmia.
- (4) Usually the disease is one occurring in the last trimester of pregnancy. It is not common before the 24th week, though rarely it has occurred about the 20th week.
- (5) In vesicular mole the incidence of pre-eclamptic toxæmia is higher than in normal pregnancy.

A great deal of research is being done in a search for the causative factor of toxæmia. A number of theories of origin have had their day and most of them now are of historical interest. The more recent trends in the conception of toxæmia will be dealt with. More and more evidence is accumulating pointing to the placenta as a causative factor. Intimately connected with placental dysfunction are the hormonal changes in pregnancy and in certain cases the nutrition of the patient. The outstanding factors will be briefly indicated.

(1) Placental Anoxia and Dysfunction. Goldblatt was able to produce hypertension by restricting the blood flow to the kidneys and producing ischæmia. This was perhaps the starting point for investigators who tried to produce hypertension in pregnancy by producing uterine ischæmia. It has been shown that if uterine arteries of pregnant dogs are constricted the blood pressure rises ; but there is no rise if the animal is not pregnant. Ernest Page has tried to prove convincingly that the placental ischæmia is a major factor in the causation of toxæmia. He suggests that the well-known predisposing causes of toxæmia produce a restriction in the amount of blood supply to the placenta, e.g. Hydramnios and multiple pregnancy, by increasing the hydrostatic tension inside the uterus ; primiparity by increasing the intra-abdominal pressure ; pre-existing hypertension and diabetes by producing a widespread effect upon the arteries of the uterus ; extreme emotional tension or shock by producing vaso-constriction through the autonomic nervous system. As a result of the ischæmia, premature degeneration of the placenta takes

place. Placenta is one of the richest sources of thromboplastin in the body. As a result of this syncytial injury by anoxia it is suggested that thromboplastin or other allied proteins are liberated which gain access to the systemic circulation. Schneider has shown experimentally that injections of thromboplastin produce thrombosis of the capillaries in the liver—a lesion seen in all cases of fatal toxæmia. When therefore such a substance liberated by the placenta gains access to the systemic circulation it damages the maternal liver giving rise to symptoms of toxæmia. However, so far no pressor substance has been found in placental extracts and therefore this theory does not explain the hypertension in toxæmia. The anoxia of the placenta not only liberates toxic products but also produces a dysfunction of the endocrine functions of the placenta.

(2) **Smiths' Hypothesis.** Smith and Smith showed that in most cases of toxæmia, there is an increase in the serum and urinary chorionic gonadotrophin concentration, and a fall in the œstrogen and progesterone content in the blood. They believe that this is due to deficient utilisation by the placenta of the chorionic gonadotrophin to produce the steroid hormones. One of the main functions of the steroid hormones is to maintain the vascularity of the pregnant uterus and the nutrition of the placenta. A fall in their levels might seriously interfere with nutrition of the placenta. Consequently, as a result of the withdrawal of the hormonal support, a toxic metabolite of tissue catabolism found in menstruating endometrium—menstrual toxin—is possibly released by the placenta and the decidua when they become ischæmic. Menstrual toxin in very small doses causes intense vaso-constriction and œdema. The Smiths believe that this type of toxin is probably released by the decidua and placenta when it undergoes premature degeneration, as a result of ischæmia, and is the cause of the toxæmia.

It is interesting to note that both the above theories lay stress on placental ischæmia. While the Smiths believe that the menstrual toxin liberated by the placenta and decidua, by the withdrawal of the hormonal support, is the factor responsible for the toxæmia, Page and his associates believe that protein products like thromboplastin liberated from an ischæmic placenta is the cause.

(3) **Renal Ischæmia.** Goldblatt by constriction of the renal arteries produced prolonged hypertension in dogs. This ischæmia of the kidney led to the release of an enzyme, renin, from its cortex which in turn activated a plasma globulin factor, hypertensionogen, which was said to be responsible for the hypertension. More recent work has shown that there exists in toxæmia a reduced renal blood flow. It is possible that renal ischæmia occurs as a part of generalised vascular spasm which in turn aggravates the existing vaso-constriction.

Trueta and his colleagues have described a mechanism whereby a cortico-medullary deviation of the blood flow occurs within the kidney substance. This shunting of blood from cortex to medulla produces ischæmia of the renal cortex which in turn gives rise to albuminuria and the liberation of a pressor substance with consequent hypertension and abnormal excretion of salt and water producing œdema. Franklin and Sophian demonstrated renal ischæmia by distension of the pregnant horn of rabbit's uterus. Sophian has suggested a utero-renal reflex as a result of a nervous stimulus arising in the uterine wall due to distension within the cavity producing renal cortical ischæmia as in Trueta's mechanism and the resulting albuminuria, hypertension and œdema. However, this theory does not explain the occurrence of toxæmia in vesicular mole or after evacuation of the contents of the uterus.

(4) Adrenal Cortical Hormones. According to Selye, the adrenal cortex secretes hormones under the influence of the anterior pituitary in response to various types of stress. This reaction of the body to various forms of stress is termed by Selye as 'The General Adaptation Syndrome'.

There are broadly speaking three groups of adrenal cortical hormones :

(1) The adrenal steroid sex hormones—œstrogen, progesterone and several androgens which are excreted in the urine as 17-Ketosteriods.

(2) The gluco-corticoids which affect the metabolism of glucose and reduce inflammatory reactions. An important member of the group is cortisone.

(3) Mineralo-corticoids which are concerned with the water and electrolyte balance—(Sodium Chloride and Potassium). Aldosterone is the important corticosteroid of this group. Desoxy-corticosterone is a synthetic substance with a similar action but Desoxy-corticosterone is not produced to any great extent by the adrenal cortex.

There is a striking similarity between pre-eclamptic toxæmia and the syndrome produced by excess of Desoxy-corticosterone. In both conditions œdema, albuminuria and hypertension are present. The excretion of corticosteroids in urine in normal and toxæmic pregnancy has been studied by various authors. The results have not been conclusive nor are they in full agreement. Evidence available seems to favour the suggestion that there is in toxæmia an increased excretion of the corticosteroids—and some believe the increase is more in the mineralo-corticoids.

It is also suggested that this increase is due not only to the hyperactivity of the adrenals induced by the hypertrophy of the anterior

lobe of the pituitary in pregnancy but also due to the fact that corticotrophin is produced by the placenta. Under this double stimulus the adrenal cortex undergoes hyperplasia and secretes excessive amounts of cortical metabolites. Excess of corticosteroids like Aldosterone can give rise to œdema, albuminuria and hypertension.

It has been shown that while intracellular sodium is low in normal pregnancy, it is considerably raised in pre-eclamptic toxæmia. Also that in pre-eclampsia there is diminished excretion of Aldosterone as compared to normal pregnancy wherein there is almost a five-fold increase in excretion as compared to the non-pregnant. As it is at present, there is no conclusive evidence relating Aldosterone to the cause or cure of pregnancy toxæmia.

According to Selye, pre-eclampsia can be classified as one of the diseases of adaptation. The adrenals respond to the stress of pregnancy by increased cortical activity usually kept within bounds by the body's adaptation to the stress. When however the adaptation fails, the cortical activity oversteps its limits. At present the information available on the subject is not sufficient to give a definite conclusion.

(5) Endocrine Factors. Hoffman and Anselmino claimed that in eclampsia both the anti-diuretic and pressor substance from the posterior Pituitary are found in excess in the blood of toxæmic patients. Other workers have however failed to confirm the findings. Browne and others have shown that the vascular system in toxæmic patients is sensitised to the action of pressor hormones and this sensitisation takes place weeks before the clinical manifestation of the disease. It is suggested that the chorionic gonadotrophin may be the sensitising factor. Many are of the opinion that in toxæmia there is an increase, in the concentration of chorionic gonadotrophin in the blood and urine, while there is a deficiency of the steroid hormones.

(6) Dietetic deficiency. It is well-known that diet and dietetic habits vary from country to country and from race to race. Socio-economic conditions play an important part in determining the diet and dietetic habits of mankind. A geographical and socio-economic survey of eclampsia has yielded very useful information. According to Deickman a geographical survey of eclampsia has shown that eclampsia is very rare in those regions of Africa where the diet and habits have not been changed by the white race. Eastman believes that eclampsia in the United States shows a striking relationship to the distribution of Vitamin B complex deficiencies. In China, Gordon King showed that there was a considerable increase in the incidence of pre-eclampsia and eclampsia in those with Vitamin B₁ deficiency. Eclampsia is common in India and Ceylon.

Results of a large number of field studies and dietetic experiments with supplementary food-stuffs have been very conflicting. Some report considerable reduction in the incidence of toxæmia when dietary supplements are used. In Holland during the Second World War, when men and women were starving, the incidence of pre-eclampsia was minimum. Many reports indicate no statistical significance in the incidence of pre-eclamptic toxæmia in relation to diet. It is therefore difficult to accept nutritional deficiency as the cause of pre-eclampsia. The conclusion that can be drawn from an impressive amount of work done is that perhaps nutrition and environment may modify the incidence and severity of pre-eclampsia and eclampsia.

From his experiments in the prevention of pre-eclampsia and eclampsia Sir Bernard Dawson in 1953 came to the conclusion that while good antenatal care has almost eliminated eclampsia it has not reduced the incidence of pre-eclamptic toxæmia.

It will be obvious from this short résumé of the important theories of pre-eclampsia and eclampsia that the last word on the ætiology has yet to be said. Much work has been done—the indications are that the placental ischæmia and the cortical hormones are important factors in the ætiology. There is also a tendency to emphasise the rôle of the familial tendency to hypertension in those who develop pre-eclamptic toxæmia.

Pathology. Generally speaking, the pathological changes in the organs are in the nature of thrombosis of capillaries and smaller veins and occasionally of the arterioles with hæmorrhages and necrosis in the areas immediately surrounding them. The liver changes are so characteristic that, by themselves, they are sufficient to warrant a post-mortem diagnosis of eclampsia. The liver may be normal in size, the surface is smooth but has a mottled appearance due to numerous scattered areas of sub-capsular hæmorrhage. The colour may be normal or pale yellow either from fatty change or jaundice. Microscopically the characteristic finding is the occurrence of fibrin thrombi in the portal capillaries in the periphery of the lobules. Surrounding the peripheral thrombi are areas of hæmorrhage and necrosis. It is said that the hæmorrhage and thrombosis in the periphery of the lobules are seen in no other condition. In addition there is a variable amount of fatty degeneration of the liver cells.

The kidneys. Renal lesions are usually found. Renal biopsy and electron microscopy have helped considerably in elucidating the renal lesions. The glomeruli are considerably enlarged often pouting into the neck of the tubules. The endothelial cells are swollen, at times blocking the lumen of the capillaries and lay down fibrils which give some of the staining reactions of collagen. There is no thickening of

the basement membrane as was believed at one time. All of the renal changes regress rapidly after delivery. Tubular changes are also common but what has been interpreted as degenerative change may perhaps be no more than an accumulation of protein absorbed from the glomerular filtrate within the cells.

The brain. There may be evidence of œdema and in some cases areas of thrombosis and hæmorrhages are met with. Multiple small petechial hæmorrhages with softened areas around them are common in the cortex, basal ganglia and the pons.

Heart. Petechial hæmorrhages and areas of focal necrosis in the myocardium are found in a majority of cases.

Lungs. May be normal or may show evidence of œdema and broncho-pneumonia.

Signs and Symptoms of Pre-eclamptic Toxæmia. Usually the onset of the toxæmia is insidious. The cardinal signs and symptoms are high blood pressure, œdema and albuminuria. Either all of them or any combination of them may be present in a case.

Hypertension. The average blood pressure of the normal pregnant woman is 110-120 mm. of Hg. systolic and 70-80 mm. of Hg. diastolic. Any increase over 130 mm. of Hg. systolic and 90 mm. of Hg. diastolic must be viewed with suspicion and systolic pressures of 140 and over and diastolic of 90 and above must be considered as high, and as indicative of toxæmia. Perhaps of all signs the blood pressure is the earliest indication of the possible onset of toxæmia. It usually precedes albuminuria, sometimes even by weeks, and often œdema also. The diastolic pressure rises first and then the systolic follows. Therefore the height of the diastolic pressure is more significant in the diagnosis than the systolic. The level of the blood pressure may not always indicate the severity of the toxæmia but, in the majority of cases, a steadily rising blood pressure indicates its severity. The importance of taking blood pressure readings regularly in pregnancy cannot be over-emphasised.

The causation of hypertension in toxæmia is still not clearly understood. The vascular spasm of the arterioles and capillaries found in toxæmia may account for it but what causes the spasm still remains a mystery. Available evidence indicates that hypertension in toxæmia is more humoral in origin and not neurogenic.

œdema. Varying degrees of œdema—usually mild—is seen in nearly 75% of normal pregnant women in the last few weeks of pregnancy. This œdema is however confined to the feet and ankles and

mostly disappears after rest in bed for eight to twelve hours. If however pitting œdema is found to persist even after twelve hours of bed rest or if the œdema is present over the face, hands, abdominal wall or the labia, it must be considered as abnormal. Such œdema may result not only from toxæmia but also from other causes—congestive heart failure, anæmia and nutritional deficiency. Varying grades of œdema are found in pre-eclampsia. In severe cases sometimes the patient is completely waterlogged. Ascites may also be present in some cases. Œdema is an early manifestation of toxæmia. It usually occurs before albumin is evident in the urine and sometimes before the blood pressure rises.

Weight Changes and Œdema. By determining the gain in weight of patients in the antenatal period, it is possible to detect abnormal retention of water in the tissues even before the œdema becomes manifest clinically. The average gain in weight throughout the whole period of pregnancy is usually about 6-9 kg. depending upon the socio-economic status of the patient. In the first trimester, there is very little gain in weight—more commonly there may be a slight loss due to hyperemesis etc. The second trimester is a period of steady gain when the patient usually puts on, on an average, 2-2.5 kg. a month. In the third trimester, the weight gain continues but towards term there is a drop in weight as labour approaches. More important than the total gain in weight during pregnancy is the rate at which this weight is put on. Any patient putting on more than $\frac{1}{2}$ - 1 kg. per week requires careful watching; for, this abnormal gain in weight is due to retention of fluid in the tissues—occult œdema—and by weighing patients as a routine such retention is discovered even before the œdema becomes manifest clinically. At the same time, it must be realised that only about 50-60% of patients, showing abnormal weight gain, develop toxæmia and nearly 30-40% of patients may develop toxæmia without abnormal weight gain. All the same, routine weighing of the patients in the antenatal period is an essential procedure in the early diagnosis of toxæmia.

Albuminuria. Albumin is present in the majority of cases of toxæmia, but it is not an early sign. It usually appears in the urine after hypertension and œdema have become manifest in the majority of cases. Spasm of the glomerular capillaries results in anoxia of the glomeruli and this gives rise to endothelial damage. As a result, proteins escape in the urine. The degree of albuminuria does not always indicate the severity of the toxæmia. Generally, however, a very heavy degree of albuminuria is associated with the severe forms of toxæmia. In addition to albumin, casts, usually hyaline, may be present in the urine.

The symptoms vary according to the severity of the toxæmia. While mild cases may have no signs or symptoms other than those mentioned above, the more severe varieties are associated with some or all of the following symptoms: restlessness, headache, vomiting, dimness of vision, epigastric pain and sometimes sudden blindness. These types of cases, if not promptly treated, often develop convulsions—eclampsia. At times convulsions may set in suddenly without any of these warning symptoms.

Clinically one could classify pre-eclampsia into mild, moderately severe and severe types, depending upon the height of blood pressure, degree of œdema and albuminuria and the presence or absence of symptoms. A patient with a blood pressure of not more than 150 mm. of Hg. systolic, with mild to moderate œdema and albuminuria unassociated with any symptoms like headache, vomiting and visual disturbances, could be classified as a mild pre-eclamptic. Where the blood pressure ranges from 150-180 systolic, with moderate to severe degree of œdema and albuminuria and is associated with headache and such other symptoms, the toxæmia is classed as moderately severe. When the blood pressure is above 180 systolic, with varying degrees of œdema and albuminuria and associated with restlessness, headache, vomiting and visual disturbances, it should be classed as severe or threatening eclampsia. Severe symptoms—vomiting, headache and restlessness—may occasionally be seen in patients who otherwise would fall in the category of the mild pre-eclamptics. The sudden onset of convulsions may be noted in such cases, while patients with very high levels of blood pressure and severe degrees of œdema and albuminuria, complain of no symptoms and remain non-convulsive. One may thus be inclined to lay emphasis on the symptoms to assess the severity of the toxæmia rather than on the height of blood pressure and the severity of œdema and albuminuria alone.

Biochemical Factors in Toxæmia. An extraordinary amount of biochemical investigations has been done in regard to toxæmia. Positive findings have been of little value and even these are contradictory. The blood urea is within normal limits in toxæmia. The renal function tests have yielded no abnormal findings, and the urea clearance values are within normal limits. In the majority of severe cases of pre-eclampsia, the blood uric acid level seems to be higher than normal. Some believe that the level of uric acid indicates the severity of toxæmia. Studies in sodium balance reveal that in toxæmia there is a considerable delay in the excretion of sodium. As a result of sodium retention the blood chlorides are increased. There is hæmoconcentration. Serum protein levels are lower than in normal pregnancy and among them the albumin fraction is most affected. There is an increase in the urinary and serum concentration of the

chorionic gonadotrophin while there is a fall in the œstrogens and progesterone content of the blood. However no correlation between the severity of the toxæmia and the relative concentration of the hormones has been observed. By using radioactive sodium it has been demonstrated that there is a definite diminution of blood supply to the placenta in toxæmia.

Changes in the Fundus Oculi. Routine examination of the fundus oculi is now an accepted and necessary procedure in the investigation and management of toxæmia. The American Ophthalmological Society has graded the retinal changes as follows :

Grade O : Normal fundus.

Grades 1 and 2 : Characterised by slight or moderate degrees of reflex strip arterio-venous narrowing and spasm—the stage of angiospasm.

Grade 3 : Above with œdema, hæmorrhage and exudates—Toxæmic retinopathy.

Grade 4 : Papillœdema.

Differential Diagnosis. Pre-eclampsia has to be differentiated from renal disease and hypertension complicating pregnancy. At times the differentiation may become very difficult. The following points will help in differentiation.

1. *History.* A history of pre-existing renal disease or hypertension prior to pregnancy indicates that it is most probably not a toxæmia.

2. *Time of Onset of Symptoms and Signs.* In pre-eclampsia, these are usually manifest only after the twenty-fourth week and seldom earlier than the 20th week. If they are manifest before the twentieth week, the presumption is that it is most likely renal disease or hypertension.

3. *Parity.* Pre-eclampsia is most common in the primigravida.

4. *Signs and Symptoms.* These may not be of much help. But in uncomplicated cases of hypertension, œdema and albuminuria are usually absent except when pre-eclampsia is superimposed on hypertension.

5. *Urinary Findings.* The presence of all varieties of casts—hyaline, granular, epithelial, etc.—is more in favour of renal disease.

6. *Renal Function.* Blood urea and urea clearance values are within normal limits in pre-eclampsia and hypertension. In renal

disease, urea clearance values are lower and blood urea is raised in the later-stages.

7. In the severer types of Pre-eclampsia the blood uric acid level is often elevated and uric acid clearance lowered.

8. *The Optic Fundus.* Albuminuric retinitis, cotton wool patches and flame shaped hæmorrhages are diagnostic of renal damage. In severe toxæmia retinopathy and papilloedema may be seen. But these clear up once the toxæmia is cured.

After delivery, the symptoms and signs totally subside in toxæmia, while in renal disease and hypertension they persist to a varying degree.

In spite of all these differences, at times, it becomes very difficult to differentiate the condition, especially in cases where no previous history is available.

The Prognosis. The prognosis may be considered from two points of view—the immediate and the remote.

The Immediate Prognosis. If the mild cases are diagnosed early and treated efficiently, the response is usually good and hence the prognosis for mother and baby is favourable. If, however, the toxæmia is severe and the case neglected, the immediate danger to the mother is the onset of convulsions—eclampsia—which makes the prognosis very grave. Sometimes premature separation of the placenta may occur—accidental hæmorrhage—adding to the dangers to mother and child. At the height of the toxæmia, the fœtus may die *in utero* and premature labour may set in. It is evident from these that the prognosis for both mother and child is grave in the severe cases.

The Remote Prognosis. For a long time it was believed that about 40% of patients developed chronic nephritis as a result of a toxæmic pregnancy. Investigations have shown that chronic renal damage seldom results from toxæmic pregnancy, however severe it might be. Available evidence indicates that instead of renal damage, about 40% of these patients develop a vascular hypertension in later life. Theobald and his supporters question this view. They have proved statistically that the deaths from hypertension in later life are no greater in the group of pregnant women who have had babies than in the nulliparous group. Therefore they believe that pre-eclampsia does not give rise to residual hypertension and such patients who develop hypertension later in life after a toxæmic pregnancy would have done so even if they had not become pregnant. The evidence is overwhelming. But the fact remains that clinically one often sees young women developing hypertension within a few years of a toxæmic pregnancy. What factors then affect the incidence of post-toxæmic

hypertension? The common belief that the severity of the toxæmia and its duration are important in the development of post-toxæmic hypertension is now questioned. From available evidence it is observed that neither the duration of the toxæmia nor its severity are of great importance. The age of the patient and a familial tendency to hypertension would seem to be the more important factors. And this fact influences the regimen of management of these cases, for in the mild and moderately severe cases, in the younger age group, pregnancy need seldom be terminated for fear of residual hypertension. Perhaps there is no other subject in obstetrics about which there are such differing views.

Recurrent Toxæmia. It is common to see a patient who had toxæmia in one pregnancy developing it in succeeding pregnancies, while remaining completely normal in between pregnancies. It is not also clear why after successive toxæmic pregnancies, the toxæmia does not occur in one or more pregnancies and recurs in a later pregnancy.

Treatment. Prophylactic. It has not always been possible to prevent pre-eclampsic toxæmia. But with efficient antenatal care, it is possible to spot the disease early and prevent it from becoming severe. Routine periodical examination of the pregnant woman, at which time the blood pressure, weight, and albumin in the urine are determined, constitutes an effective method in the early diagnosis of toxæmia.

Treatment of Mild Cases. In these cases the blood pressure is below 150 mm. systolic; œdema and albuminuria are mild and there are no other symptoms. Hospitalisation is advisable. The treatment consists of:—

1. *Rest.* Absolute rest in bed for a few days will help to clear the œdema and bring down the blood pressure in a few days.

2. *Diet.* The diet requires regulation. It should consist largely of carbohydrates, less of proteins and little of fat. The average calorific value of the diet should be about 2,500 calories. On an average the salt content of the ordinary diet is about 15-20 gm. This must be reduced to at least 6-7 gm. per day if not entirely cut off for a few days. There is no necessity to reduce the intake of fluid. On the other hand, generous amount of intake of fluids should be encouraged.

3. *Elimination.* Administration of diuretics help in clearing up the œdema. Various oral diuretics have been employed in the control of œdema—acetazolamide (Diamox), Chlorthiazide and Hydrochlorthiazide (Esidrex). Of these, Hydrochlorthiazide is the one of

choice. In doses of 50-100 mgm. orally daily it helps to produce marked diuresis, increases to a great extent the urinary sodium and chloride excretion and there is very little potassium depletion. Hence in the management of toxæmia it is extremely useful.

The improvement in the patient is usually made out by the drop in blood pressure, disappearance of œdema, loss in weight and disappearance of albumin from the urine. Most of the mild cases can be treated successfully on these lines.

Moderately Severe and Severe Cases. These result usually from neglect of mild cases. These patients have very high ranges of blood pressure—160 and over—marked degrees of œdema and albuminuria in association with symptoms like restlessness, vomiting, headache, epigastric pain and visual disturbances. Such cases should always be treated in institutions and not in the home. They require intense and specialised care.

The aim of the treatment in these cases is to allay restlessness and headache by the administration of sedatives, to reduce the blood pressure and get rid of the œdema and albuminuria.

General. These patients must be kept at complete rest in bed with good nursing attention. A fluid intake and output chart which records the amounts of fluids given and the amount of urine passed and the amount of vomit if any, must be maintained. At the end of twenty-four hours this chart gives an idea of the fluid balance of the patient. The blood pressure should be recorded every four hours and every day the urine should be tested for albumin and its quantity determined.

Diet. There is no harm in withholding solid food from the patient for a few days. The patient is given only liquid nourishment to start with—barley water, fruit juice and diluted milk. The amount of fluid given should not be unnecessarily limited, even in those with severe œdema. Rigid restriction of fluids in these cases is harmful rather than beneficial and so the patients are encouraged to drink as much as they want but not forced to do so. As the condition of the patient improves, the fluid diet is replaced gradually by ordinary diet—with the usual precautions—restricted salt, plenty of carbohydrates, moderate amount of protein and little of fat.

Sedatives. Sedatives are specially indicated in cases where the patient is restless and has severe headache. The common sedatives employed are pethidine, Barbiturates and chlorpromazine. Magnesium sulphate 15-20% solution given parenterally is very useful.

The Control of Blood Pressure. The most important factor in the control of blood pressure is rest in bed—absolute rest both physical

and mental. Drugs are of very limited value. Various drugs have been employed to control the pressure in toxæmia. When blood pressure rises to high levels, to get an immediate control, an intravenous injection of the thalazine derivative 'Apresoline' 20 mgm. in 20 ml. of 5% glucose injected slowly usually assures a reasonable drop of blood pressure within 15 minutes to half an hour in the majority of cases, but this lowered pressure is maintained for varying periods ranging from 3-26 hours, the average being 14.6 hours. The injection can be repeated when the blood pressure goes above 160 mm. of Hg. systolic. 'Apresoline' has very little side effects—does not adversely affect the cardiac output, increases the renal and cerebral blood flow and is more reliable than any other hypotensive drug. Various hypotensive agents are now available; to mention a few, Serpentina group of alkaloids, Hexamethonium compounds, Protoveratrine, Guanethidine and others. Chlorpromazine is another drug with hypotensive and sedative effects, in addition to its various other actions. Given intramuscularly or intravenously in 25 mgm. doses, it produces a sharp fall in blood pressure and has a good sedative effect. It can be given orally in 25 mgm. doses every 4-6 hours if necessary. It is extremely useful, especially in the management of eclampsia, which is discussed later. The obstetrician may choose any one or any combination of drugs he prefers. Oral administration of hypotensives has not proved satisfactory. Parenteral administration has yielded better results. If decrease in the incidence of eclampsia and perinatal mortality is accepted as a criterion for judging the efficacy of any treatment, we are constrained to admit that the hypotensives have not helped to any significant extent. Their main use is to get an immediate control of blood pressure, especially in labour when it is likely to rise to high levels. For this purpose, whatever be the hypotensive employed, it must be quick in its action, prolonged in its effect and should have no harmful effect either on the mother or the child.

Control of Œdema and Albuminuria. As in blood pressure, to a certain extent, enforced rest helps in the control of œdema. Administration of diuretics by mouth helps in clearing the œdema. Of special use is the administration of hypertonic glucose solution intravenously—25% glucose in doses ranging from 100 ml. to 500 ml. or more daily, very often helps in promoting diuresis and clearing the œdema. The dosage necessarily depends upon the severity of the œdema. Oral administration of Hydrochlorthiazide in doses of 100-150 mgms. daily is extremely useful in producing marked diuresis and reduction of weight and œdema. Fruesimide (40 mg.) daily is an extremely potent diuretic. These diuretics may increase the loss of potassium as well as salt and water and precautions must be taken against potassium loss.

With this line of treatment, majority of cases respond favourably. There are, however, cases which do not respond to treatment and in whom complications may arise. In such cases pregnancy may have to be terminated.

Indications for Termination of Pregnancy. The most important indications are:—

1. To prevent the onset of eclampsia.
2. To prevent intra-uterine death of the child.
3. To prevent a residual hypertension occurring later in life.

Some of the severe pre-eclampsics exhibit symptoms of threatening eclampsia. These are severe headache, marked restlessness, epigastric pain, vomiting and visual disturbances. In such cases, if within a few hours of the administration of the sedatives and hypotensives, the symptoms are not brought under control, irrespective of the period, it is desirable to terminate the pregnancy to save the mother from eclampsia which enhances the dangers to the mother and the child. Sometimes, while the patient is under treatment, these symptoms may develop and if they cannot be controlled, it is much better to terminate pregnancy.

While under treatment, the eye grounds should be frequently observed and if changes suggestive of Grade 3 or 4 are found developing it is better to terminate pregnancy. The fundal changes usually disappear in a short time after termination of pregnancy. Permanent visual damage seldom results from toxæmia. Even cases of sudden blindness due to retinal detachment which at times occur improve after termination of pregnancy.

Pre-eclampsia is associated with high foetal mortality because of premature labour in many cases and intra-uterine death of the foetus as a result of placental insufficiency associated with the toxæmia. In cases not responding to treatment, induction of premature labour has to be resorted to.

Babies born earlier than 36th week are very difficult to rear. The baby has a better chance if the termination of pregnancy can be postponed to at least after the 38th week. In the absence of threatening eclampsia, the medical management of the toxæmia should be persisted with. And once the desired viability is reached, if the patient is not responding satisfactorily to treatment, it is safer to terminate pregnancy. For, the continuance of the pregnancy may result in intra-uterine death of the foetus due to persisting toxæmia. In such cases to assess the danger to the foetus estimation of urinary œstriol is useful. Values below 4 mgm. in twenty-four hours after the 34th week of pregnancy are suggestive of foetal distress indicating ter-

mination of pregnancy. However it is unwise to depend upon a single estimation. Falling æstriol levels as pregnancy advances would seem to be more significant. And lastly to prevent the occurrence of post-toxæmic hypertension, the pregnancy may be terminated in cases not responding to the medical treatment of toxæmia within a reasonable time. This is a questionable indication and is discussed under remote prognosis.

Methods of Termination. Medical induction of labour is often a failure in these cases and therefore not advocated. The two methods commonly employed are :—

1. Artificial rupture of the membranes.
2. Cæsarean section.

Artificial rupture of the membranes is an ideal method in cases where the cervix is effaced and the presenting part engaged. Labour comes on within a short time, especially where the rupture is done below the presenting part, and follows the normal course. In those cases where the cervix is uneffaced and the presenting part unengaged in primigravidæ, artificial rupture of the membranes is followed by a long latent period before the true pains start. The fœtal mortality in these cases is higher than in the previous variety and of late there is an increasing tendency to resort to cæsarean section in these cases—cases with unengaged heads and long closed uneffaced cervix—to save the fœtus, especially when the toxæmia is severe. Cæsarean section is also indicated when there is co-existing disproportion and in elderly primigravida.

Most of the babies born of toxæmic mothers in whom labour is induced are small and premature. Among the causes of neonatal deaths in these cases prematurity stands first, so that unless one has all the modern facilities for the management of premature infants, all that cæsarean section will do is to shift the fœtal mortality from the column of still-births to that of neonatal deaths. And lastly if cæsarean section is undertaken, the best results are obtained when general anæsthesia is avoided (epidural or local anæsthesia is preferable) and lower segment section is the operation of choice.

In cases where there is no danger of imminent eclampsia but pregnancy has to be terminated, a modified surgical induction, can be employed especially in cases with a closed uneffaced cervix and unengaged head, as an alternative to cæsarean section. The membranes are stripped by the finger all round the external os and the patient is started on an intravenous oxytocin drip—2½ units in 500 ml. of 5% glucose. The rate of the drip is adjusted according to the nature of contractions—usually 20-30 drops a minute. When the uterus begins to act, the membranes are ruptured below the presenting part.

At times, if there is no urgency, the oxytocin drip is given on two or three consecutive days to soften and efface the cervix and the membranes are then artificially ruptured. Cæsarean section to save the fœtus will still have to be considered if the induction fails or fœtal distress supervenes early in labour. This combination of artificial rupture of the membranes and oxytocin drip sometimes even saves the patient from cæsarean section. Antibiotics may be administered prophylactically in all cases.

Management of Labour. Patients with pre-eclampsia in labour require careful attention, for during labour the blood pressure may rise to high levels and then along with labour pains the patient may develop intrapartum eclampsia. The aim in management should be to prevent eclampsia and to save the fœtus. These ends can be achieved if the patient is kept sedated in labour, the blood pressure controlled by hypotensives and the total duration of labour reduced without in any way increasing the maternal and fœtal morbidity and mortality. As a routine 100 mgms. of Pethidine is given intramuscularly to these patients and repeated every 4-6 hours and if the blood pressure is over 160 mm. Hg. systolic hypotensives are given parenterally. To accelerate labour, the membranes are ruptured artificially and when the head is on the perineum it is delivered by forceps under pudendal block anæsthesia.

The sedation and hypotensives are continued if necessary for another 48 hours, as chances of eclampsia developing are minimal after 48 hours of delivery. Prophylactic antibiotics and administration intravenously of 20% dextrose are also employed.

If, in early labour, blood pressure rises to very high levels and cannot be controlled by hypotensives, and vaginal examination reveals that labour is going to take time, cæsarean section will have to be considered to save the mother from eclampsia and the fœtus from intrapartum death. It would be wise to do a cæsarean section in elderly primigravida with severe pre-eclampsia. Patients with severe pre-eclampsia are unsuitable candidates for trial labour and cæsarean section would be the better line of treatment if cephalo-pelvic disproportion is present. In severe cases, if uterine inertia complicates labour, cæsarean section will have to be considered, while in the milder types of toxæmia, in the absence of disproportion, intravenous oxytocin drip to stimulate uterine action could be given.

Results. In the mild grades of pre-eclamptic toxæmia the maternal mortality is usually nil. In the severe grades, excluding eclampsia, cerebral hæmorrhage and acute pulmonary œdema may cause maternal death. In the mild cases the perinatal mortality varies from 5-6% and in the rest between 15-20%. In 60% the cause is prematurity.

It is necessary that careful medical management be continued in the postpartum period also. The remarkable feature of the disease is the striking improvement in the patient's condition within a few days of delivery. All signs and symptoms usually disappear completely within a few weeks.

Future Pregnancies and Toxæmia. In a number of patients uneventful pregnancies and deliveries follow a toxæmic pregnancy. But in some, while the patient maintains perfect health in between pregnancies, in the succeeding pregnancies albumin appears in the urine and blood pressure rises and œdema sets in. These cases were previously thought to be due to occult nephritis. The term is now obsolete. These are only cases of recurrent toxæmia and should be treated on the same lines as pre-eclamptic toxæmia. A curious feature of the recurrent toxæmia is its appearance in some and absence in other pregnancies. For example, the first toxæmic pregnancy may be followed by a normal second and third pregnancy, the fourth may again be however toxæmic. This behaviour of the toxæmia in skipping some pregnancies still remains unexplained.

Hypertension Complicating Pregnancy

A woman suffering from hypertension may become pregnant. Such a pregnancy may be uneventful or may give rise to complications.

Blood Pressure and Pregnancy. In certain number of cases with hypertension, it is found that during pregnancy there is a drop of about 10-20 mm. of Hg. in the systolic pressure about the middle of the second trimester. The pressure begins to rise again in the third trimester and may or may not reach levels higher than the pressure at the start of the pregnancy. At times the pressure continues to rise throughout the pregnancy, while in yet others, no marked variations are seen. The first group has a good prognosis, while the second group has a bad prognosis.

Hypertension predisposes to toxæmia. In the majority of cases, when the systolic pressure is above 160 mm. of Hg., albumin appears in the urine and œdema may set in. This indicates the superimposition of toxæmia in cases with hypertension. However it is not uncommon to see cases with very high levels of blood pressure—180-200 or more—with no albumin in the urine.

The Course of Pregnancy and Prognosis. In uncomplicated cases of essential hypertension, the pregnancy usually runs an uneventful course, unless pre-eclamptic toxæmia supervenes as evidenced by the occurrence of albuminuria. In such cases the prognosis for the

mother and the child is rendered worse. Premature separation of the placenta and intra-uterine death of the fœtus are common in such cases. Prognosis is also bad where the patient starts her pregnancy with a systolic pressure of 160 mm. of Hg. or more and where the pressure steadily rises during pregnancy.

The remote prognosis in these cases is the same as in pre-eclamptic toxæmia. There is no proof that repeated pregnancies in a patient with hypertension aggravates her hypertension in later life. But it is possible that such aggravation may take place if pre-eclamptic toxæmia is superimposed on hypertension.

The differential diagnosis of hypertension from toxæmia has been discussed in the section on toxæmia.

The Treatment. These patients require careful watching throughout pregnancy. Rest is the essential factor. It is in the management of essential hypertension complicating pregnancy that hypotensive drugs have a valuable place. They can be given orally and should be continued perhaps throughout pregnancy depending upon the response. A physician's help is valuable in the management of these cases. X-ray of the heart, electrocardiogram, examination of eye grounds and urine, and renal function tests should all form part of the investigation. In uncomplicated cases there is no necessity to terminate pregnancy, except when toxæmia supervenes.

If possible, the pressure must be kept below 160 systolic to prevent the onset of toxæmia. So long as toxæmia does not complicate the condition, the prognosis for the mother and baby is favourable. Such cases almost always go to term and are delivered safe. Superimposition of toxæmia as evidenced by albuminuria and rising pressure is a bad sign. If by the usual lines of treatment, toxæmia is not brought under control, the pregnancy is best terminated, especially when symptoms of restlessness, headache and visual disturbance set in.

Sympathectomy in Hypertension. This is useful in selected cases and is said to give better results if the diastolic pressure is high and pulse pressure low. It should be considered if the outlook for a successful pregnancy is poor. The usual operation is bilateral lumbo-dorsal sympathectomy with removal from 8th dorsal to 3rd lumbar sympathetic trunk. A time interval of at least one year after operation is desirable before a pregnancy. This operation is not recommended as a part of the treatment of hypertension in pregnancy. From the reported series it would appear that pregnancy is safe in a patient who had a successful sympathectomy for hypertension.

Malignant Hypertension. This is a very grave condition. Pregnancy is associated with very great risks to the mother and fœtus.

Under the circumstances, it is best not to allow the pregnancy to continue but terminate it as soon as possible.

Eclampsia

This is a convulsive disease occurring in pregnant, parturient or puerperal women, usually characterised by high blood pressure, albuminuria, œdema, and such symptoms as headache, dizziness, disturbances of vision, epigastric pain, convulsions and coma, sometimes ending fatally.

Incidence. Eclampsia is a preventible disease. Efficient antenatal care has almost eliminated this disease in countries where such care is available and utilised by the pregnant mothers. It is more common among primigravidæ than among multiparæ. Over 75 per cent of the cases occur in primigravidæ. The disease varies not only in its incidence but also in its severity. It has been suggested that eclampsia occurs more frequently when the humidity is greater and particularly during the winter and rainy seasons; but a careful investigation into the incidence in relation to atmospheric conditions over a number of years has not revealed any definite increase in the particularly humid months of the year or when the rainfall was much greater.

Causation. The ætiology of pre-eclampsia and eclampsia is the same and has been dealt with under pre-eclamptic toxæmia. It has been suggested that patients with cerebral dysrhythmia are more prone to develop convulsions in a toxæmic pregnancy.

Pathology. The pathological changes that may occur are discussed earlier in the section on pre-eclamptic toxæmia.

Clinical Signs and Symptoms. In a large number of cases of eclampsia the signs and symptoms of pre-eclamptic toxæmia are present. In cases of the fulminant variety no signs or symptoms may be present, and a fit may be the first warning. The chief symptoms of an imminent attack of eclampsia are headache, giddiness, disturbances of vision such as dimness, flashes of light, photophobia or even complete blindness, vomiting and epigastric pain. Together with these symptoms a sudden rise of blood pressure, particularly over 160 mm. of Hg. systolic or 100 mm. of Hg. diastolic, presence of albumin in urine, diminution in the quantity of urine, sometimes actual suppression, would give a graphic picture of an imminent disaster in the shape of an eclamptic convulsion.

The Eclamptic Convulsion, or the Fit. When the woman actually develops the convulsive attack, four stages are recognised:—

1. The premonitory stage.
2. The tonic stage.
3. The clonic stage.
4. The stage of coma.

The Premonitory Stage. During this stage the patient becomes unconscious, the pupils dilate, the eyes are turned to one side and fixed, or roll from side to side; twitchings of the face and hands may occur. This stage may last from a few seconds to half a minute.

The Tonic Stage. The whole body now becomes rigid, the features are distorted, the arms flexed and hands clenched, the body being in a condition of tonic spasm. This stage lasts for a few seconds and is followed by the clonic stage.

The Clonic Stage. In this stage there is alternate contraction and relaxation of the muscles; the jaw is clenched, the tongue may be bitten; the twitchings begin in the face, around the angle of the mouth, and gradually extend to the arm and the leg on one side of the body; then the whole body is involved in the convulsive attacks. The face is cyanosed, and if the patient is not properly protected she may fall from the bed and injure herself, sometimes seriously. The tongue protrudes and during the clonic convulsions may be bitten badly. There is froth in the mouth; the breathing becomes stertorous. This stage lasts from half to two minutes and the patient then passes into the fourth stage, the stage of coma.

Coma. In this stage the convulsive movements cease; a few jerks or twitchings may take place at intervals. The patient lies quiet, stertorous breathing becomes established, coma supervenes, and the respirations gradually quieten down. In favourable cases the patient wakes after a short time and is not conscious of anything that has taken place before.

The temperature may rise during a fit; the pulse rate is increased and the blood pressure may be raised. The fits may occur every few minutes, or at longer intervals. Sometimes, even after a single fit, the patient may pass off into deep coma from which she may not recover. In other cases fits may occur in quick succession leading to a condition called status eclampticus where the patient goes on working continuously into convulsions. On the other hand, the patient may remain in a state of coma almost throughout.

If albuminuria was not present before the attack it usually appears

after the first fit. Reduction in the amount of urine is constant, and in some cases there may be anuria.

Time of Onset of Fits. Eclampsia is more frequent during the last trimester and may occur either—

1. Antenatal (intercurrent eclampsia) where the patient recovers from an attack and the pregnancy continues.
2. Antepartum—occurring before the onset of labour, often leading to termination of pregnancy.
3. Intrapartum—occurring when the woman is in labour.
4. Post-partum—occurring for the first time after delivery.

Post-partum eclampsia occurs frequently within the first twenty-four hours after delivery. Rarely does it occur later than 48-72 hours after delivery. In cases of antepartum eclampsia, labour pains may start soon after the eclamptic fit; or occasionally the woman may completely recover and pregnancy may continue. The term intercurrent or antenatal eclampsia is used to denote cases where the fits are controlled and the pregnancy continues for at least ten days after cessation of convulsions.

Diagnosis. Pregnancy may be complicated by diseases like epilepsy, hysteria, cerebral tumours, meningitis and other diseases which give rise to convulsions. These have to be borne in mind in the differential diagnosis of eclampsia. However when in a pregnant woman with no history of pre-existing convulsive disorders fits occur in association with albuminuria, hypertension and œdema, the diagnosis would obviously be eclampsia.

It is at times difficult to distinguish between post-partum eclampsia and post-partum cerebral venous thrombosis wherein also convulsions occur. The latter condition usually occurs later in the puerperium commonly after the fourth day and at times is associated with convulsions, while post-partum eclampsia is rare after the first 48-72 hours. A history of pre-eclampsia prior to delivery would point towards eclampsia. Sometimes lumbar puncture helps in differentiation.

In all cases of convulsions in pregnancy it is better to start with the presumption that they are eclamptic fits, till by differential diagnosis other causes have been definitely established.

Complications. Injuries varying from bruises to fractures may result. The tongue is usually bitten and in some cases it may be so badly injured that it gets swollen, may fall back and occlude the

glottis during the period of unconsciousness, causing suffocation and even fatal asphyxia.

Cerebral hæmorrhage, hyperpyrexia, pulmonary œdema, renal failure, psychosis, neurological lesions and puerperal infection are other complications.

Prognosis.—*Maternal.* The prognosis with any particular line of treatment should always be based on the study of a large number of cases treated. Variations do occur as regards severity of the disease. It is not at all uncommon to find a series of cases responding very favourably to a particular line of treatment, but sooner or later cases occur in which the same method of treatment gives very unsatisfactory results. In fact no conclusion should be drawn unless a series of at least a hundred cases have been treated by a particular method.

Various factors influence the prognosis in eclampsia. They are :

1. *Parity.* The prognosis is more grave in multiparæ.
2. *The Time of Onset of Convulsions.* In our experience antepartum eclampsia has the highest maternal mortality. The mortality rate for different types of eclampsia in a series of 1151 cases is given below :

Type of eclampsia	No. of cases	No. of deaths	Percentage mortality
Ante-partum	826	145	17.5
Intra-partum	61	4	6.5
Post-partum	264	25	9.3

3. *Fits—their frequency and duration.* The greater the number of fits, and the less the interval between them the graver is the prognosis. With more than twelve fits the prognosis is generally considered grave.

4. *Coma.* The deeper the coma, the graver is the prognosis. If the patient is conscious or semiconscious in between fits, the prognosis is better.

5. *Temperature and Pulse.* A rising temperature mounting to hyperpyrexia is an ominous sign. In fact hyperpyrexia is a common cause of death in eclampsia. A temperature above 102° F. and a pulse rate over 120 should be considered as a bad omen.

6. *Blood Pressure.* There is no direct relationship between the height of blood pressure and prognosis. Very high levels of blood pressure—over 200 mm. of Hg. systolic—are of bad prognosis. At

the same time several cases of severe eclampsia with blood pressure levels not exceeding 140 mm. of Hg. systolic have been observed.

7. *Edema.* Very severe degree of œdema as also absence of œdema are considered as bad signs.

8. *Albuminuria.* It is doubtful if the degree of albuminuria by itself gives any definite indication as to prognosis usually. If albuminuria is heavy and persists in association with high blood pressure, the prognosis is not favourable.

9. *Oliguria, Hæmaturia and Anuria* are complications of extremely grave prognostic significance. These indicate cortical necrosis or acute tubular necrosis. Few survive cortical necrosis of the kidney in eclampsia.

10. *Interval from onset of Convulsions to Delivery.* In uncontrolled eclampsia the longer the time interval between the onset of convulsions and delivery the greater the mortality.

11. *Other Complications.* Pulmonary œdema and broncho-pneumonia are common complications in eclampsia which make the prognosis very grave and enhance maternal mortality. Cerebral hæmorrhage is a fatal complication in severe eclampsia. Neurological complications like hemiplegia or paresis of one or more extremities are sometimes seen. These are usually the result of vascular spasm and often the patients recover fully.

Remote Prognosis. Residual hypertension may be present in about 30-40% of women after eclampsia, though some believe that complications in succeeding pregnancies are more likely after pre-eclamptic toxæmia which has been allowed to persist for some time.

The fœtus. The prognosis is bad for the fœtus for three reasons :—

1. The severity of the toxæmia induces anoxia of the fœtus.
2. Premature births are common; either spontaneous or induced.
3. The drugs used to control the convulsions affect the fœtus adversely.

All the same it is sometimes very surprising to see babies born of severe eclamptics, in spite of repeated convulsions in the mothers, and sedation, showing no trace of asphyxia at birth.

Treatment. The treatment is considered usually under two heads—the prophylactic and curative.

Prophylaxis. It has been amply demonstrated that efficient antenatal care can eradicate eclampsia. Routine, regular visits to the ante-

natal clinics must be made compulsory, if eclampsia is to be eradicated. At every visit the blood pressure and weight should be recorded and urine tested for albumin, in addition to the other routine examinations. Any tendency towards a rapid increase in weight—more than $\frac{1}{2}$ Kg. a week—should rouse the suspicion of a commencing toxæmia. So also fluctuating levels of blood pressure over 130/90 mm. of Hg. The emphasis should be on the diastolic pressure of 90 mm. of Hg. or above. Albuminuria is not an early sign. Antenatal care helps to spot the cases of pre-eclamptic toxæmia early, and with proper care they seldom go on to the severe variety, and still less to eclampsia. In severe cases, if the patient is not responding satisfactorily to treatment, pregnancy should be terminated to save the mother. It is needless to add that in the antenatal management restriction of salt and regulation of diet are important.

Curative

The management of eclampsia is essentially on conservative lines advocated strongly by Stroganoff of Russia and Tweedy of Rotunda. They relied on sedation to control convulsions.

The treatment is discussed under the following heads :

- (1) General management
- (2) Sedative line of treatment
- (3) Hypotensive management
- (4) Obstetric management

General Management. Even from very early times the general management in the treatment of eclampsia played a very important role in its prognosis. All patients ought to be nursed in a quiet dark room. All attendants, medical and nursing, should wear noiseless shoes and handling of the patients should be reduced to the minimum. Examination of the patient must be gentle and quick and done only after the patient is under the effect of a sedative. Thus external stimuli to the patient could be reduced. The throat should be kept clear of mucus ; raising the foot of the bed or lowering the head will help postural drainage of the upper respiratory tract. In cases with a lot of secretion, suction will help. Oxygen should be at hand and all measures to treat asphyxia should be available. Careful nursing and attention to prevent injury during a fit are imperative. A soft firm mouth gag introduced in time will save injury to the tongue. At times asphyxia may set in. Heroic measures like tracheotomy are seldom necessary to save an eclamptic from an asphyxial death, though a few cases have been reported where it has been done. Chloroform inhalations to stop convulsions adopted by Stroganoff are not recommended.

Fluid Balance and diuresis. One of the most important details in the management is the proper maintenance of fluid balance and a good urinary output. Intravenous administration of 20% dextrose not more than 1000 ml. in 24 hours has been found to be of great help in promoting diuresis by many authorities.

Antibiotics. Penicillin prophylactically has been used as a routine in all cases of eclampsia with satisfactory results to combat the danger of infection.

The sedative line of treatment. The modern management of eclampsia consists in the administration of sedatives on a planned time schedule. If after some hours of such treatment the convulsions are not controlled pregnancy is terminated either by artificial rupture of membranes or by lower uterine segment cæsarean section.

Many sedatives and their combinations have been employed in the treatment of eclampsia—each clinic has in fact its own regime of management but the underlying principles are the same. The commonly employed sedatives are Morphia, Paraldehyde, Barbiturates, Magnesium sulphate and the Basal narcotics—Tribromethanol and Sodium Thiopentone.

Morphia is given intramuscularly in $\frac{1}{4}$ gr. doses and repeated not earlier than 2-3 hours. Not more than 2 gr. are to be given in 24 hours. Many clinicians believe that Morphia suppresses urinary secretion.

Paraldehyde can be given by rectum or intramuscularly. The latter route is preferred. Usually 7-10 ml. is given intramuscularly and smaller doses 5-6 ml. repeated sixth hourly. Morphia and Paraldehyde alternately have also been employed.

Magnesium sulphate has been extensively used in the treatment of eclampsia. Usually 10-20 ml. of a 15-25% solution is given either intramuscularly or intravenously. The drug is repeated every four hours—not more than 20 gms. is given 24 hours. The knee jerks should be tested before each dose and the drug withheld if the jerks are absent.

Among the Barbiturates the common ones employed are Sodium Luminal, Barbital Sodium, (Nembutal) and Phenobarbitone. These are usually given in 0.3 gm. doses intramuscularly and repeated every 4-6 hours.

Tribromethanol is a basal narcotic. It is administered per rectum in doses of 4.5 ml. in 250 ml. of water. The dose is not repeated

earlier than 4 hours and usually two instillations are given. Occasionally a third may be necessary.

Sodium Thiopentone (Pentothal) is another basal narcotic. 0.5 gm. of pentothal in 10 ml. of distilled water given intravenously is an admirable first aid in the management of eclampsia as it helps in immediate control of convulsions. This can be supplemented by 3 gms. of Pentothal in one litre of 20% dextrose solution given slowly as an intravenous drip over a period of 24 hours.

After trials with various combinations of drugs a 'standard regime' which has been found to give very satisfactory results has now been established. The drugs employed are chlorpromazine (Largactil), Promethazine (Phenergan) and Pethidine.

The regimen is as follows :

0 hours—25 mg. of Chlorpromazine and 100 mg. of Pethidine in 20 ml. of 5 per cent glucose are given intravenously, and

50 mg. of Chlorpromazine and 25 mg. of Phenergan intramuscularly.

A drip of 20 per cent dextrose solution containing 200 mg. of Pethidine is then set up and this is run in slowly at 20 to 30 drops a minute, the rate depending upon the response to treatment. If the patient is quiet, the rate of the drip is reduced ; if restless it is increased till she is quiet. Not more than 1,000 ml. of 20 per cent dextrose is given in 24 hours and in all not more than 300 mg. of Pethidine in the 24 hours.

0 to 4 hours	Phenergan (Promethazine)	25 mg.	intramuscularly
0 to 8	„ Largactil (Chlorpromazine)	50 mg.	intramuscularly
0 to 12	„ Phenergan	25 mg.	intramuscularly
0 to 16	„ Largactil	50 mg.	„
0 to 20	„ Phenergan	25 mg.	„
0 to 24	„ Largactil	50 mg.	„
0 to 28	„ Phenergan	25 mg.	„
0 to 32	„ Largactil	50 mg.	„
0 to 36	„ Phenergan	25 mg.	„
0 to 40	„ Largactil	50 mg.	„
0 to 44	„ Phenergan	25 mg.	„
0 to 48	„ Largactil	50 mg.	„

If fits are not controlled within 8-10 hours of start of treatment and the patient is not in labour, the cervix uneffaced and the head is unengaged, a lower segment cæsarean section is done under local anæsthesia. Should vaginal examination reveal quick response to induction—well effaced cervix, engaged or well fixed head—artificial rupture of the membranes is done. Vaginal delivery is helped in the second stage by outlet forceps under pudendal block anæsthesia.

The main advantages observed by this combination of drugs are (1) the satisfactory drop in blood pressure in 60% of cases, (2) the good control of convulsions—recurrence rate only about 15%, (3) the good urinary output, (4) almost total absence of secretions from the upper respiratory tract, (5) marked diminution in the incidence of pulmonary œdema, hyperpyrexia and shock even in those delivered by cæsarean section. The maternal mortality in 1448 cases treated on these lines was only 2.4%.

Hypotensive Management. A state of hypertension is said to predispose to eclamptic convulsions. The occurrence of eclamptic convulsions is usually preceded by sudden rise in blood pressure and it was therefore thought that the reduction in blood pressure may be useful in the management of eclampsia. Under the influence of hypotensive agents the blood pressure would drop, cerebral tension would be decreased and the convulsions would cease. To bring about this result the hypotensive agent used should not only be rapid in its action but enduring in its effect. It should be harmless to the mother and the fœtus and should have no unpleasant side-effects. Various hypotensive agents have been used in the management of eclampsia. But very few obstetricians have used hypotensives only in its management.

It is pertinent here to point out that severe eclampsia can occur with normal blood pressure, though hypertension is commonly met with. It is also noticed that fits can persist in spite of the control of blood pressure. In a series of 1460 cases there were 220 cases of eclampsia with blood pressure not exceeding 140 mm. of Hg. systolic and where the fits persisted. Therefore it is but reasonable to conclude that, while control of blood pressure will help in the management, too much should not be expected from this treatment alone. It is a useful adjuvant.

Obstetric management. Forceful methods of delivery have no place in the management of eclampsia. Induction of labour by A.R.M. in patients in whom the convulsions cannot be controlled within 8-10 hours of start of sedative treatment on a planned schedule and cutting short the second stage of labour by outlet forceps under pudendal block anæsthesia would be the treatment of choice.

In the majority of cases marked improvement follows delivery.

The occurrence of postpartum eclampsia does not however invalidate this fact. As stated elsewhere previously (1) antepartum eclampsia has the maximum mortality, (2) also the longer the interval between the onset of convulsion and delivery the worse the prognosis. Therefore it would be reasonable to terminate pregnancy in those antepartum eclamptics in whom the convulsions cannot be controlled by the routine sedative management within a reasonable time 8-10 hours. Where vaginal examination reveals a favourable response to induction, A.R.M. is the method of choice. In those patients with unfavourable factors—long closed uneffaced cervix and a floating presenting part—lower uterine segment cæsarean section preferably under local anæsthesia should be performed. It is emphasised that cæsarean section should not be employed as a routine in the treatment of eclampsia but only judiciously and only under the conditions previously stated. Under such circumstances cæsarean section does not enhance the maternal mortality from eclampsia. On the other hand it helps to reduce it.

The complications. These have already been dealt with. Prophylactic use of antibiotics have remarkably reduced the incidence of pulmonary and puerperal infection. Pulmonary œdema is a grave sign and when it occurs the mortality is high. Injection of atropine and morphia and administration of oxygen are the usual lines of treatment. Hyperpyrexia is controlled by cold sponging; antipyretics are not of much use and most cases are fatal. Post-eclamptic psychosis is not uncommon and usually responds to chlorpromazine. Renal failure should be treated on the lines indicated in the chapter on renal failure.

After-care. These patients require to be carefully watched even after delivery is over. Sedation—less intensively—should be continued for 48 hours. In some cases the convulsions are easily controlled and the pregnancy continues. It is not essential to terminate pregnancy especially when the fœtus is premature. The patient should be carefully observed and pregnancy need be terminated only when the blood pressure continues to rise and albuminuria persists. This line of management is done mainly in the interests of the fœtus.

Maternal mortality. Maternal mortality from eclampsia is high especially in those who had no antenatal care. The common causes of death are (1) cerebral hæmorrhage, (2) pulmonary œdema, (3) renal failure, (4) hyperpyrexia. To reduce maternal mortality it is not enough to control the convulsions but these complications also should be controlled. Herein lies the value of the combination of chlorpromazine and promethazine group of drugs. As stated already, by

using these drugs and judicious employment of cæsarean section the mortality has been reduced to 2.4%.

The foetal mortality is high in eclampsia—30-60%. The main reasons being the toxæmia itself, prematurity and the sedatives employed.

A brief summary of the treatment of eclampsia with results, carried out at the Government Hospital for Women and Children, Madras, is given below.

Treatment	No. of cases	Maternal mortality rate %
Morphia, Chloraland, Bromide, Paraldehyde, Mag. Sulpha—A.R.M. if convulsions are not controlled	1150	15.1
Magnesium sulphate and morphia.. ..	105	11.6
Rectal Bromethol	85	6.5
Sodium Thiopentone	75	16
Chlorpromazine, Promethazine and Pethidine. If fits are not controlled within 8-10 hours—A.R.M. or C.S.	1448	2.4

DISEASES OF THE CARDIOVASCULAR SYSTEM

PROFOUND and interrelated adjustments of the cardiovascular system are among the many changes in the maternal organism which accompany pregnancy. These include an increase in cardiac output, the pulse rate and peripheral arterial pulse pressure. Each of these is found to reach a peak six to eight weeks before term and to decline significantly before the onset of labour. The blood volume increases during pregnancy, largely as a result of an increase in plasma volume, and reaches its peak at the time of the maximum cardiac output—six to eight weeks before full term. Oxygen consumption is increased during pregnancy. This increases progressively until term but is proportionately less than the increase in cardiac output so that a decrease in arteriovenous oxygen difference occurs across the lungs. In the last weeks of pregnancy while the fœtus continues to grow, the heart rate falls and the cardiac output diminishes. However, at the same time, the oxygen consumption, the venous pressure in the leg and the total body water remain at a high level. Changes in respiratory mechanics also occur during pregnancy. There is an increase in the vital capacity.

These changes found in normally pregnant patients have been found to occur in pregnant women with cardiac disease. It is also found that, during pregnancy, exercise increases the strain on the cardiovascular and respiratory systems. The cardiac output response to a standard amount of exercise would seem to be greater during pregnancy than in the non-pregnant state.

Cardiovascular changes occur during labour and puerperium also. Oxygen consumption rises during labour. The increase is discontinuous as a result of intervening periods of uterine relaxation. The average oxygen consumption in a labour of average duration is near that of intermediate muscular exercise. With more severe pains the oxygen consumption may reach levels seen in severe exercise. It does not drop to normal immediately after delivery, but takes time. All these readjustments after parturition and puerperium are complete in about two weeks following delivery.

The incidence of heart disease in pregnant women varies with geographical location and with the frequency of predisposing diseases such as rheumatic fever and syphilis. In the Government Hospital for Women and Children, Madras, there were 434 cases among 44,445

deliveries, i.e., 0.97%. Rheumatic infection accounts for 90% of the cases of heart disease in pregnancy. The following were the types of heart lesions found in the 434 cases :—

Congenital heart disease	... 44 (10.14%)
Acquired heart disease	... 390 (89.86%)

Types of lesions :—

Mitral stenosis	... 269
Mitral stenosis with incompetence	... 41
Mitral regurgitation	... 11
Mitral stenosis and Atrial septal defect	... 4
Aortic stenosis	... 3
Aortic stenosis and incompetence	... 11
Aortic incompetence	... 6
Disease of Aortic and Mitral valves	... 29
Auricular fibrillation	... 13
Heart block	... 1
Myocarditis	... 1
Pericardial effusion	... 1
Congenital heart disease	... 44
Total	... 434

The Diagnostic Criteria of Heart Disease. Many authors have stressed the similarity of certain physiological changes in normal pregnancy to the symptoms and signs of rheumatic heart disease. In 60% of normal pregnant women dyspnoea may occur on exertion. The heart is displaced by the rising uterus and may seem enlarged. The radiographic appearance of such a displaced heart may resemble that seen in mitral stenosis and various kinds of murmurs could be heard over the præchordium, in normal pregnancy giving rise to mistaken diagnosis of organic heart disease. Hence it is necessary to make sure whether the patient has really an organic heart lesion. There are certain accepted signs of heart disease; of these the important ones are (a) the presence of a diastolic murmur which is indicative of an organic lesion except in the rarest instances, (b) unequal cardiac enlargement shown by X-ray examination—this is made difficult in pregnancy because of the normal increase in size of the cardiac shadow apparently due to diaphragmatic elevation and rotation of the heart on its long axis as the uterus enlarges, and (c) presence of systolic murmur of marked intensity, severe arrhythmia and other evidence of heart disease like pericardial rub, and anginal pain.

Classification of Heart Disease. The disease can be classified in terms of ætiology, anatomical lesions and functional capacity. Such a description of the disease assumes increasing importance in the

light of the present progress in medical and surgical therapy. For the obstetrician it is extremely necessary to know the functional classification. The classification that is generally in vogue to indicate functional capacity is as follows :—

- I. Patients with cardiac disease but without resulting limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnœa or anginal pain.
- II. Patients with cardiac disease resulting in slight limitation of physical activity. They are comfortable at rest.
- III. Patients with cardiac disease resulting in marked limitations of physical activity. They are comfortable at rest.
- IV. Patients with cardiac disease resulting in inability to carry on any physical activity without discomfort. Symptoms of cardiac insufficiency are present even at rest.

The Assessment of the Risk. The following factors have to be taken into account in assessing the risk of pregnancy and labour :

(1) *The Ætiology of the Lesion.* In cardiology the present day trend is to place more and more emphasis on the ætiological factors responsible for the organic lesion. As the life history of such lesions are studied, more light is thrown on what is likely to occur in such patients, should pregnancy supervene. As rheumatic infection plays the most important part in cardiac lesions during child-bearing period, a knowledge of the course of rheumatic carditis, its rate of progress from initial infection to death either from congestive failure or embolism is of great importance in its management during pregnancy. It has been clearly demonstrated that the mean duration of life from onset of infection until death is about 15 years. The disease usually manifests itself at an average age of 17 years and the first symptoms of cardiac insufficiency become manifest as a rule about 28 years of age. At about 30 years congestive failure often sets in and death usually occurs within 3-5 years of onset of congestive failure.

(2) *The Age.* In general the patient is fit for ordinary physical activity for 10-12 years from the date of cardiac involvement. The evidence is in favour of poor prognosis after the age of 30 by which time slow deterioration and congestive failure often become manifest. Hence the age at which pregnancy occurs is an important factor in prognosis. Generally speaking the younger the patient the better the prognosis, whereas after the age of 30 the probabilities are more in favour of occurrence of cardiac incapacity and congestive failure. A patient with a rheumatic heart will stand pregnancy and labour better in the early twenties than in the thirties. We observe however that in our experience decompensation sets in at an earlier age, about 25 years. It is possible that socio-economic conditions necessitating

preponderance of hard labour may be a factor precipitating early decompensation.

(3) *Functional Grade.* This is of fundamental importance, especially to the study of the damaged heart in pregnancy. A careful study of the history will enable the obstetrician to arrive at a fairly accurate estimate of the functional capacity of the heart and classify it according to the New York Heart Association classification. The woman should be placed in the approximate grade when she first comes under observation and grading correlated to the duration of the pregnancy. The lower in the scale and the earlier her pregnancy, the worse the prognosis. Experience shows that patients in Grades I and II need give rise to little concern at any stage in pregnancy, if under proper supervision. Most of them go through pregnancy and deliver naturally at term. Those in Grade III are in danger and those in Grade IV are in very grave peril.

History of Previous Pregnancies and Deliveries. In women who have previously borne children, their performance during pregnancy and labour will be available as a guide in assessing the prognosis in the present pregnancy. Where in a previous pregnancy a patient has been in Grade III or Grade IV the chances are mostly that she will revert to that grade in the present pregnancy also. If she was in Grade I or II and is still relatively young it is possible that she will maintain the same functional grade. However, if there has been a long interval between pregnancies, it is possible that she may go down to a lower grade in the succeeding pregnancy. It is believed that the deterioration is due to the progressive nature of the lesion with age and not due to the pregnancy itself.

Cardiac arrhythmia, especially auricular fibrillation, is a sign of bad prognosis. Hypertrophy and enlargement of the heart and the nature of the valvular lesion do not seem so important as the age of the patient and the functional grade in assessing the risks of pregnancy.

Anæmia in a patient with a cardiac lesion definitely increases the risks to the mother as it may, at times, not only make the diagnosis of an organic lesion difficult but also precipitate congestive failure in these cases.

The Nature of the Lesion. Upto now the emphasis in prognosis has been on the functional efficiency of the heart rather than on the nature of the valvular lesion in assessing the prognosis. The advent of intra-cardiac surgery has changed this approach. It is now of fundamental importance in all cases, especially in functional Grade III or IV, to know which of the valves is affected. Mitral stenosis of the grade of incapacity could be treated by valvotomy. Surgery has not

been found to yield satisfactory results in mitral incompetence. Aortic lesions are also unfavourable. It is fortunate that mitral stenosis which is most amenable to surgical treatment is the commonest affection found in pregnancy.

And lastly, in assessing the prognosis the socio-economic status of the patient, institutional and other help available should be taken into consideration.

Management of Pregnancy. Efficient antenatal care plays an exceedingly important part in the management of these cases. A thorough examination should be made when the patient presents herself to determine the functional grading and the nature of lesion of the heart. Along with the previous history, it should now be possible on the basis discussed earlier to assess the risks to the patient and arrive at a prognosis.

The whole aim in the management is the prevention, early diagnosis and prompt and efficient treatment of heart failure during pregnancy. Grades I and II patients can be treated as out-patients. They should be seen at least fortnightly until thirty weeks and then weekly until term. Ideally the patient should be seen by the obstetrician with the cardiologist in consultation. At every visit the patient should be asked whether there is any increase in breathlessness on exertion or limitation of her activities. Increasing dyspnœa, orthopnœa, and cough are all signs of pulmonary congestion and should be looked into. Physical examination may reveal congestion at the base of the lungs. Radiological examination will further help in diagnosis of congestive failure. When a suggestion of congestive failure is present, the patient should be hospitalised forthwith.

Congestive failure is most likely to occur at the time of the maximum cardiac output—between 30th and 34th week. Hence many suggest that all cardiac patients are best hospitalised after the 30th week, even though they are Grades I and II functionally. These patients are advised to take as much rest as they can while leading a normal life. At least two hours rest in the afternoon and ten hours sleep at night are essential. They should not do any work which makes them breathless. Sudden and excessive physical exertion must be avoided. It is better to restrict salt in diet. Anæmia, if co-existing, must be effectively treated.

Grades I and II cases on this regime may be treated as out-patients but must be hospitalised after the 34th week. Delivery must be conducted in an institution only. Grades III and IV should be admitted into hospital at least by the 30th week. Complete rest in bed for all grades some weeks prior to delivery in a hospital helps to ensure maximum cardiac reserve at the onset of labour.

When failure is present it should be treated energetically. Absolute rest in bed is essential. Salts and fluid should be reduced and diuretics administered to reduce the œdema. Hydrochlorthiazide 100-150 mgms. daily or Fruesimide 40 mgms. daily given with proper precautions are very useful. Digitalis should be administered in all cases of congestive failure, more especially if the failure has been precipitated by auricular fibrillation. In very severe cases Digoxin may be given by injections intravenously or intramuscularly to obtain rapid digitalisation and then maintained by oral therapy. Depending upon the pulse rate and degree of failure the dosage should be adjusted. Morphia, oxygen and venesection are indicated when acute pulmonary œdema is present. The pregnancy should be left severely alone and under no circumstances should termination of pregnancy be considered in the presence of failure, even if the failure is not responding to treatment. Labour in a patient with congestive failure is often disastrous and so are any methods of termination of pregnancy at that stage. Sometimes in these cases of congestive failure premature labour sets in, which makes the prognosis very grave.

Attacks of congestive failure may occur at any time in pregnancy. The earlier failure sets in in pregnancy, the worse is the prognosis. It also happens that after successful management of the failure once, it may set in again and again in different periods of the same pregnancy. With early hospitalisation and proper management in most of these cases the prognosis could be improved, though still grave. One of the main indications for valvotomy during pregnancy in uncomplicated cases is the repeated attacks of acute pulmonary œdema. Valvotomy has helped to improve the prognosis considerably in these cases.

Management of Labour. There is general agreement that vaginal delivery is the safest for this group of cases and that cæsarean section must be avoided if possible. The cardiac patient does not stand a laparotomy well. The sudden emptying of the uterus as occurs in a cæsarean section leads to a damming back of the venous circulation to the right heart while in vaginal delivery which is much slower, adjustments take place reducing this risk. The post-operative distension, which at times follows a laparotomy, embarrasses the heart, occasionally precipitating failure, and post-operative vomiting, which cannot always be avoided, makes the condition worse. Therefore in these cases cæsarean section should be resorted to only if it cannot be avoided owing to other indications. Heart disease alone is not an indication for cæsarean section. It is believed, however, that in cases of coarctation of aorta, delivery is best effected by cæsarean section, as there is great danger from rupture of cerebral vessels during the process of labour. Prolongation of labour is also harmful to a cardiac

patient. Hence they are unsuitable for trial labour. Cæsarean section may be resorted to earlier in these cases.

During vaginal delivery, in the first stage of labour, the patient should be at rest in bed. The pulse rate should be carefully watched and on any unwarranted acceleration of the rate, digitalis should be administered. Sedatives like pethidine 100 mgs. or morphia $\frac{1}{4}$ gr. could be given with benefit. If dyspnœa sets in, oxygen should be given through a mask or nasal catheter. Labour in these patients is fortunately quick. When the head comes on to the perineum, extra strain to the heart should be avoided by outlet forceps delivery under pudendal block anæsthesia. Use of oxytocics, ergometrine especially, as routine in the management of the third stage of labour is best avoided. While post-partum hæmorrhage is not common, some amount of blood loss may be beneficial in these cases. Intravenous ergometrine may sometimes raise the blood pressure which is not favourable in these cases. In all cases, measures to combat failure which may set in at any stage should always be on hand.

These patients require careful attention in the puerperium. At times without any reason sudden death occurs on the third or fourth day. Hence absolute rest in bed is essential. Rise in temperature, acceleration of pulse rate and hurried breathing may indicate the onset of subacute bacterial endocarditis. Antibiotics administered prophylactically may not prevent this complication. Hence, some advise only curative antibiotic therapy if endocarditis sets in. There is no objection to the mother nursing the baby in Grades I and II lesions. In Grades III and IV the mother is not in a fit condition to nurse the baby.

The Question of Future Pregnancies. Rheumatic heart lesion being of a progressive nature, the deterioration seen in these patients is really the result of the progressing lesion and not the effect of pregnancy. It is believed that if a patient goes through one pregnancy without failure, there is no reason why she should not go through another successfully. If failure occurs in a later pregnancy, it is not due to the pregnancy but to progressing lesion. Should a patient develop failure in one pregnancy, it is almost certain that she will develop it in the next and hence in such cases it is better she has no further pregnancies. It is safe to permit pregnancies only in those in Grades I and II and among these only in those who did not develop failure in a previous pregnancy. Those in Grades III and IV should avoid conception. Grades I and II patients should be content with two or at the most three children in the absence of failure. The younger the patient, the better she can stand the strain of pregnancy.

Indications for Abortion. In modern practice indications for therapeutic abortion are very strictly limited. Patients in Grades III and IV should avoid pregnancy. If they do not and are seen in the first trimester, it is best to empty the uterus vaginally, if possible after controlling the failure. Should, however, they are seen when pregnancy is beyond 16-18 weeks, vaginal evacuation is hazardous and abdominal hysterotomy is associated with greater risks. Hence, except under exceptional circumstances, it would seem advisable to continue treating the failure without interfering with the pregnancy. The majority of these bad cases get into premature labour and mortality is high among them. Thus the only indication for termination of pregnancy is in the first trimester in Grades III and IV. It is unwise to attempt termination after 16 weeks when the load on the heart is steadily increasing to reach a maximum by the 34th week. There is more to be said in favour of sterilising the husbands of cardiac patients rather than submitting the latter to puerperal sterilisation. With modern methods of management, the maternal mortality in respect of these cases has been reduced to between 2% and 3%. Such good results are possible only when institutional facilities are available and when close co-operation exists between the cardiologist and the obstetrician.

Congenital heart disease is less common in pregnancy when compared with rheumatic lesions. Of all lesions, patent ductus arteriosus would seem to be the commonest one. Patients in the acyanotic group tolerate pregnancy well. It is rare for those in the cyanotic group to become pregnant. But the modern surgical treatment of such conditions will result in more and more of this group of patients becoming pregnant in future. In patients with coarctation of aorta, delivery should be by cæsarean section for fear of rupture of cerebral vessels during labour.

Cardiac Surgery and Pregnancy. If mitral stenosis is the predominant valvular lesion, mitral valvotomy would give satisfactory results. An increasing number of successful pregnancies, after valvotomy, is being recorded. Valvotomy in pregnancy carries a higher operative mortality and in Grade III cases it is best that the operation is carried out before or in between pregnancies. Valvotomy in pregnancy is probably more dangerous than relying on medical management, but, with improvements in technique, better results from surgery are now being reported.

TUBERCULOSIS AND PREGNANCY

PULMONARY tuberculosis is not uncommon during the child-bearing period. While genital tuberculosis often results in sterility, extra-genital lesions are no bar to conception. Indeed routine radiographic studies have shown that the incidence of pulmonary tuberculosis in pregnancy is between 1 to 2 per cent.

The Influence of Pregnancy on Pulmonary Tuberculosis.

It was generally thought that pregnancy aggravated pulmonary tuberculosis. Deterioration was said to take place in the early months due to associated hyperemesis, and later in the puerperium. In fact one of the oft-quoted sayings was 'For the virgin no marriage, for the married no pregnancy, for the pregnant no future confinement and for the mother no suckling.' Enough evidence has now been accumulated to prove substantially that the course of pulmonary tuberculosis is unmodified by pregnancy and that the disease takes the same course in pregnant women as in non-pregnant women. The lesions remaining the same, there is no difference in mortality between pregnant and non-pregnant women. What was originally thought to be a high mortality due to pregnancy is now shown to be due only to the normal course of the disease. The conclusions drawn from a large number of investigations carried out in recent years show that (1) pregnancy does not adversely affect the course of pulmonary tuberculosis, (2) in a woman with a quiescent lesion, pregnancy is not contra-indicated, and (3) while for a pregnant woman with an active lesion the prognosis is not good, it is no worse than in a patient with the same type of lesion who is not pregnant.

Effect of Tuberculosis on Pregnancy. Tuberculosis does not affect fertility except when it is very advanced or where the generative organs are involved. Ordinarily pregnancy is not interfered with and the fœtus is well developed. Rarely has tuberculosis been transmitted to the fœtus *in utero*. In the vast majority, the placenta forms an efficient barrier to such transmission. The greater danger is the possibility of infection of the new-born from the tuberculous mother by close contact.

The Treatment of Tuberculosis. This need be mentioned only in general terms here. Close collaboration with a physician is essential if good results are to be obtained. Sanatorium line of treat-

ment still has its place and to this is now added treatment with Streptomycin, P.A.S. and I.N.H. (1 gram of Streptomycin daily along with 3 grams of P.A.S. or 200 mgm. of I.N.H.) for a period of three months is the usual treatment advocated. Repetition of the course twice or thrice, after a break of a month, will be necessary depending upon the response and the lesion. The majority of the lesions respond satisfactorily to this therapy. In cases not responding, collapse therapy in the form of artificial pneumothorax, phrenic avulsion or thoracoplasty and lobectomy in selected cases may be indicated. It is to be remembered that pregnancy is no bar to the active and intensive treatment of tuberculosis. It was previously held that, especially in the later months of pregnancy, a tuberculous patient improved due to the growing uterus pressing on the diaphragm and helping to produce a sort of basal immobilisation of the lungs and that in the puerperium these cases got worse as a result of the reduction in size of the uterus following delivery, thus removing the beneficial effects of immobilisation in pregnancy. Recent studies do not confirm this view. Induction of Pneumoperitoneum soon after delivery or at the end of puerperium had its own strong advocates in the treatment of pulmonary tuberculosis, but enthusiasm for this line of treatment has died down and is seldom employed since the advent of antibiotics and chemotherapy.

Management of Labour. The tuberculous patient is unfit for a prolonged labour. Hence in the first stage anxiety should be allayed by sedatives and the second stage cut short with outlet forceps as soon as possible. Pulmonary tuberculosis is not an indication for cæsarean section, which should be performed only for obstetric indications. Throughout labour, the patient's general strength must be supported. The baby should be removed from the mother and breast feeding not permitted. B.C.G. vaccination should be carried out on all such infants. Active treatment of tuberculosis should be continued in the puerperium also.

Induction of Abortion. In the past active pulmonary tuberculosis was an indication for early termination of pregnancy. Instead of terminating pregnancy, the present tendency is to treat effectively, with the modern facilities available, the pulmonary lesion on medical lines and surgical methods if necessary. There are however some to whom such treatment may not be available and to whom domestic help and other facilities which are so very necessary, especially after confinement, are totally unobtainable. These socio-economic conditions are given as reasons for resorting to abortion in these patients.

Even when a patient with a quiescent lesion has become pregnant, the present concept is that with the proper management of tuber-

culosis, pregnancy could be allowed to continue under close and careful supervision.

At times, where surgery is contemplated for the effective treatment of tuberculosis, the presence of pregnancy may be a hindrance to the proper performance of the operation. Under such circumstances where pregnancy interferes with the proper treatment of tuberculosis, it should be terminated. Laryngeal tuberculosis which was considered as an indication for abortion is not so regarded now, as it responds well to modern treatment. Thus, the place of induction of abortion for pulmonary tuberculosis would seem to be almost negligible indeed.

Non-pulmonary tuberculosis may occasionally complicate pregnancy.

Tuberculosis of the Spine:

The association of pregnancy with active spinal caries appears to be a very infrequent occurrence. When it occurs, the difficulty of combining the weight and size of the gravid uterus with the usual methods of treatment of the spinal condition may be sufficient indication for therapeutic abortion. Quiescent cases should be allowed to proceed to term.

Sacro-Iliac Tuberculosis:

The softening of the sacro-iliac ligaments, and the strain on the sacro-iliac joints which normally occurs during pregnancy and labour, should be remembered in cases of active or recently quiescent tuberculous disease. While therapeutic abortion is probably only necessary in cases of severe disease, cæsarean section at or near term is to be recommended in such cases.

Renal Tuberculosis:

In patients with active renal tuberculosis who become pregnant, the added load which pregnancy normally places on the kidneys may be a vital factor. The prime consideration is the extent of the tuberculous lesion and the amount of normal renal tissue remaining. In those cases of active disease with a bad tuberculous prognosis, therapeutic abortion is probably advisable, but in quiescent cases, or for example in a patient who has had one kidney removed, the remaining one showing no evidence of active tuberculous disease, pregnancy may safely be allowed to continue. In nephrectomized patients, the remaining kidney undergoes a physiological hypertrophy during pregnancy, and if other omens such as blood pressure and renal function tests are favourable, pregnancy is unlikely to do harm.

ACUTE MATERNAL VIRAL INFECTION AND
INFECTIOUS DISEASES

INFECTION during pregnancy can be viewed in terms of its significance for the mother—i.e. increased morbidity and mortality—or in relation to its effect on the foetus. The relation between foetal and maternal infection is a complex one because of the presence of the placenta. In addition, the endocrinologic features peculiar to the pregnant state exert an effect on the maternal response and presumably account for the increased incidence and severity of certain diseases in pregnant women.

The rôle of the placenta is a changing one during the course of gestation. After the first 12 weeks it acts as a barrier to foetal infection while it does not do so earlier. Pathologic changes occur in the placenta in some virus infections but not in others. Rubella, herpes simplex, Varicella, smallpox and vaccinia all result in lesions of the vilious tissue which include acute inflammation, necrosis and granulomatous changes. In contrast virus infections of the foetus (poliomyelitis, coxsackie B) leave no discernible evidence in the placenta. It seems clear that some viruses do not affect the placenta; others may infect the placenta but extend no further while still others spread from the placenta to the foetus and may cause severe damage.

During the last two decades considerable evidence both clinical and experimental has accumulated indicating that the gestational age at the time of foetal viral infection is a critical factor in the determination of the incidence, type and multiplicity of the malformations induced. In general it may be stated that the earlier in pregnancy the foetal infection occurs the more numerous and severe will be the resultant congenital defects in the foetus. The later the infection the more limited will be the type of defects. It is therefore important to realise the rôle of viral infections not only in causing abortions, premature births and intra-uterine deaths but also its importance in the causation of congenital abnormalities in the foetus especially if viral infections occur in the first few weeks of pregnancy.

Influenza

Perhaps, one of the serious complications in pregnancy is influenza. This has been made evident in recent epidemics by the large toll of both maternal and foetal deaths. Owing to the high temperature

and respiratory embarrassment when the lungs are involved abortion or premature labour is frequent.

The prognosis in severe cases especially when it occurs in an epidemic form is grave for mother and fœtus. The management is essentially medical and obstetric assistance may be required when abortion or labour sets in.

Vaccines are now available. If an epidemic of influenza is anticipated immunisation of pregnant women is advisable particularly in those near term.

Variola—Small pox

Pregnant women are more susceptible to this disease than men or non-pregnant women. The severe varieties of the disease—the hæmorrhagic variety—is more common during pregnancy and the mortality is also higher among them.

Abortion, premature labour and intrauterine death of the fœtus are commonly met with during the course of the disease. The gross fœtal wastage could be as high as 40%. The placenta is not a barrier to the passage of the virus. During the stage of viræmia, the virus in the blood has every chance of passing through the placenta to the fœtus *in utero* and infect the fœtus. It is indeed surprising that even in the severe forms majority of the fœtuses are not infected and do not develop the disease after birth. In fact only about 10% of the babies do show signs of disease at birth or within ten days of birth. The exact reason for this phenomenon is not clearly understood.

The treatment of this disease in the gravid condition differs little from the treatment of smallpox at other times, except that all precautions should be taken to avoid premature labour, as labour at the time when the infection is active will be an additional strain.

Occasionally, when the child is born during the eruptive stage of the disease, the question arises as to what precautions should be taken to see that it does not develop smallpox. Isolation is absolutely necessary, and it may be well to vaccinate the new-born child in the hope that the vaccine will take effect before the possible occurrence of smallpox and thus mitigate its severity.

During an epidemic of smallpox in the community, all pregnant women should be vaccinated. It is possible that the protective influence of vaccination is also transmitted to the fœtus. Vaccination of the mother during pregnancy rarely exerts a deleterious effect on either the mother or the fœtus. However, definite cases of fœtal

vaccinia have been reported. It is most desirable, if the mother has not been vaccinated, to vaccinate the infant soon after birth when an epidemic is prevalent in the locality.

In a recent epidemic the mortality among pregnant women was 31.7%. The gross foetal wastage was 38.7%. Premature labour occurred in 42.1%. The mortality rate in vaccinated pregnant women was 20.7% as compared to 75% in those not vaccinated. On an average the maternal mortality rate in pregnancy was nearly three times that in the non-pregnant.

It would appear that the 'pregnancy status' has a disease enhancing property with the result that the pregnant woman faces far greater risk of developing severe varieties of smallpox especially the hæmorrhagic variety.

Rubella

Rubella is an important cause of foetal wastage and congenital malformation. When maternal infection occurs in the first 12 weeks of gestation the estimated risk of foetal malformations detectable in the neonatal period is approximately 20%. When children are followed over a period of years the recognition of impaired hearing and other anomalies increases the rate to approximately 35%. There is also evidence that preconceptional rubella can result in foetal defects. Maternal infection in the second trimester also carries some hazard but much less than when it occurs in the first trimester. Because of these, therapeutic abortion is advocated when Rubella infection occurs in the first trimester.

Rubella vaccine is now available. But as it contains live virus, its use in pregnancy is contraindicated as the vaccine has been demonstrated to infect the placenta and foetus. It is therefore recommended that the vaccine be used primarily for school aged children. If feasible a serologic test for immunity should be made to identify susceptible adolescents and women. Vaccine should then be given to them only if there is virtually no chance of pregnancy in the ensuing two months.

Other Viral infections. Infective hepatitis is a very serious complication in pregnancy which has been discussed earlier. Pregnant women intimately exposed to hepatitis in the family setting should be given immune globulin (human). This if administered soon after contact modifies the infection and prevents the disease.

At least a dozen viruses are now identified as being significant in causing foetal or new born infection and disease. Prominent among

these are rubella, cytomegalovirus infection and herpes simplex. Rubella may cause malformations of the heart, cataract, deafness, microcephaly and mental retardation. Cytomegalovirus may produce microcephaly, chorioretinitis, deafness and mental retardation while herpes simplex infection may give rise to generalised herpes, encephalitis, death, and during the neonatal period to microcephaly, microphthalmos and retinal damage.

Specific measures to prevent infection with herpes simplex are not available. If a pregnant woman is harbouring the virus in the genital tract it is possible that the fœtus may be badly infected during a vaginal delivery.

CHAPTER XXII

VENEREAL DISEASES

Syphilis

SYPHILIS is one of the diseases which, in a pregnant woman, shows its effect not merely on the mother but also on the offspring, and in some cases transmits its adverse effects even to the third generation. A significant number of miscarriages, still births, intrauterine maceration and neonatal deaths may result from syphilitic infection in the mothers. But repeated abortions occurring more or less at the same period of pregnancy are not generally due to syphilis.

Effect of syphilis on pregnancy. The effect of this disease on pregnancy and the foetus depends upon the time of infection and the treatment adopted. The maternal infection can occur before pregnancy, at conception or later. As the years pass from the time when the mother contracted syphilis the likelihood of a foetus showing serologic or other evidence of syphilis diminishes despite lack of treatment. Untreated syphilis contracted more than a few months to several years prior to pregnancy usually causes midtrimester abortion or foetal death *in utero*. Abortion early in pregnancy is uncommon. When infection occurs at the time of conception or early in pregnancy and therapy is not given the foetus deformed by congenital syphilis is often delivered prematurely. Syphilis contracted by the mothers in the second half of pregnancy may or may not result in a syphilitic child.

If treatment be vigorously adopted at any stage, the course of events may be controlled and it is possible to ensure that the woman is delivered of a healthy child; or, if treatment has been adopted somewhat late in pregnancy, that she is delivered of a live child which, if properly treated, may overcome the manifestations of the disease.

Effect of Pregnancy on Syphilis. In most cases, syphilis runs a mild course during pregnancy, but some of the secondary manifestations such as condylomata and skin rashes may appear in an aggravated form, probably because of the increased vascularity.

The adverse effect of syphilis upon the foetus is so great that it is now an invariable rule in all ante-natal clinics, irrespective of any previous history or otherwise, to do the routine serological tests, in every case. The V.D.R.L. test is the one now usually done. It is

surprising how in some cases, with no evidence of syphilitic infection and no history, these tests prove the presence of infection. The incidence of V.D.R.L. positive pregnant women in the Madras Government Hospital for Women and Children is about 7%.

In every case where a diagnosis of syphilis has been made, treatment should be started immediately and must be done thoroughly. Pregnancy is no bar to the proper treatment of syphilis in the mother. On the other hand, the possibilities of carrying pregnancy to full term are much greater, if thorough treatment is adopted.

Treatment. Penicillin therapy—A full course of 4.2 million units of procaine penicillin G with 2% Aluminium Monostearate (PAM) spread over a period of one week and given intramuscularly is usually advocated.

The treatment should be repeated if the serological test remains positive. It is not sufficient to treat the mother, as in a large number of cases the treatment might have been started at such a late stage that complete cure for the child cannot be guaranteed. The child may be apparently normal at birth but may show the manifestations of syphilis at a later stage. For this reason, it is necessary that the child should also be treated. Simultaneously with the treatment of the mother, it is desirable that the other parent should also be subjected to treatment.

Patients receiving this therapy, both prior to and during pregnancy, have almost a 100% chance of having a non-syphilitic infant. All patients with a history of syphilis should be treated during each pregnancy without consideration of serological reactions or amount of previous therapy. Serological reactions during pregnancy present a certain degree of inconsistency. When weak reactions are repeatedly observed, therapy should be instituted, especially if a history is obtained of still-births or abortions or suspicious lesions or positive reaction in the husband.

So far as the child is concerned, the mother can suckle the infant, though it may show manifestations of syphilis. A syphilitic infant stands in greater need of mother's milk than a healthy infant. On the other hand, 'wet nursing' should never be adopted, as there is great danger of the infant infecting the nurse.

Gonorrhœa

Gonorrhœa is not infrequent in pregnant women, the infection occurring either prior or subsequent to conception. Pregnancy would appear to favour exacerbation and extension of the infection.

Gonorrhœa exerts a definitely adverse influence upon the pregnant woman and may cause abortion, miscarriage, premature labour and puerperal infection. In cases where the infection has been of some standing and the tubes are not affected, women with gonorrhœal infection may become pregnant. The cervix, more than any other part of the genital tract, is the site at which gonorrhœal infection persists longer. The primary site of infection in 95% of the cases is either the cervix or the urethra. A vaginitis is very rare. Complications, such as gonorrhœal arthritis and gonorrhœal endocarditis, are noted more often during pregnancy and peritonitis during the puerperium. The chief period when gonorrhœa in a woman shows its most adverse effect is in the puerperium. At this time, because of the dilatation of the passages, the bruising of the tissues and the opening up of large venous spaces, the infection that has been limited to the cervical canal or the urethra or the ducts of the vulvo-vaginal and urethral glands rapidly spreads to the uterine cavity, thereafter gaining admission through the tubes into the peritoneal cavity, and thus a severe form of puerperal peritonitis may result.

The treatment of gonorrhœa has been radically altered in recent years. The response to chemotherapy is dramatic; all clinical symptoms of discharge, external irritation and inflammation subside rapidly, and smears and cultures become negative after 24 hours of treatment.

Excellent results are obtained with antibiotics. Procaine penicillin in doses of 4,00,000 units daily for two days gives dramatic results. Terramycin 250 mgms., in capsules four times a day for two days, cures the infection immediately.

Care of the Child. Gonorrhœal conjunctivitis is the chief danger that threatens the infant, the eyes being infected during its passage through the birth canal. To prevent the occurrence of ophthalmia neonatorum, prophylactic treatment should be adopted. As soon as the head is born, the eyes should be wiped with absorbent cotton moistened with boric acid solution—10 grains to 1 oz. This should be followed as quickly as possible by a thorough irrigation of the eyes with a similar solution, after which 2 drops of a freshly prepared 1% solution of silver nitrate should be instilled into each eye, making sure that the solution falls into the eye and not upon the lids, and that it is well distributed.

To prevent late infection in the puerperium, the mother should be warned of the infectious nature of the discharge and the offspring should not be permitted to occupy the same bed as the infected mother. Should gonorrhœal ophthalmia develop, it is better to place the infant under the care of a competent ophthalmologist. The eye should be

carefully irrigated with a 10 per cent boric acid solution and silver nitrate solution, 1 per cent, instilled two or three times a day. The sound eye should be suitably protected. Penicillin ointment (ophthalmic) is of value.

Granuloma Inguinale (Granuloma Venerum)

This condition is widely prevalent in different parts of India and in several of the tropical countries. This disease commences in most cases on the genitals, usually on the labia minora or the groin in women, and advances either by continuous eccentric peripheral extension or by auto-infection of the opposing surfaces. Its extension is very slow and it gradually covers a large area. The obvious risks involved in an ulcerating growth spreading over the labia and surrounding parts at the time of labour, or even during the course of pregnancy, make it necessary that early treatment should be adopted. This condition should be differentiated from malignant and syphilitic ulceration about the labia and groin, which may also be found in pregnant women. It differs from these clinically, histologically and therapeutically. The chief characteristics are :—

1. Its extreme chronicity.
2. Absence of any cachexia.
3. Non-implication of the lymphatic system.
4. Failure of response to anti-syphilitic treatment.

Unless there is a coincident syphilitic infection, the V.D.R.L. test is negative. Its characteristic mode of spread suffices to distinguish it from epithelioma. Biopsy will clinch in diagnosis.

Treatment. Streptomycin, 1 gram daily for 20 days, is very effective in the management of these cases. Terramycin is described as a valuable drug in the treatment of granuloma inguinale. The dosage varies depending on the severity of the lesions from 0.5 gm. thrice daily for 9 days to 1.0 gm. thrice daily for 20 days. In pregnant women, if the treatment is started sufficiently early, the lesions may heal before labour sets in. Vaginal examinations in labour should be restricted, and as far as possible delivery should be left to natural powers. Where extensive ulcerations are present cæsarean section should be preferred. So also if there is extensive scarring from healing.

ANÆMIA IN PREGNANCY

ANÆMIA is perhaps the most common complication in pregnancy met with in the tropics. The severe forms of anæmia are as common as toxæmia and they contribute to a major percentage of maternal deaths.

Elsewhere it has been mentioned that certain characteristic hæmatological and biochemical changes take place in the blood in normal pregnancy. By blood volume studies on the same women throughout pregnancy and puerperium it has been shown that the total blood volume increases by about 30%, the increase in plasma being about 50% and the increase in total cell volume about 20%. Thus even though there is an increase in the total hæmoglobin mass a state of physiological anæmia is said to exist during pregnancy as a result of the hydræmia. Repeated estimations of hæmoglobin during pregnancy show a drop in the hæmoglobin level as the pregnancy advances. But this lowering of hæmoglobin is not severe enough to give rise to symptoms and hence it is termed physiological anæmia.

The Normal Blood Picture in Pregnancy. There is in normal pregnancy a fall in the red cell count, hæmoglobin concentration and hæmatocrit values beginning in the first trimester. It is a progressive fall. However there is a great divergence in the values reported. The values in Southern India are certainly much lower than those reported from the West. As a result of detailed study of a large number of normal pregnant women the following values have been noted by us :—

	Hb. in gms.	R.B.C. in Millions	Mean cell volume MCV in cubic microns	MCH rr	MCHC %
A.	10.5	3.75	90	28	31.1
B.	10.1	3.5	95	28.8	30.42

Hb. 14.5 gms. = 100% A. 24 to 32 weeks. B. 32 to 40 weeks.

The bone marrow of these patients has been examined and it was found that in normal pregnancy, the bone marrow is normal and is normoblastic. In 95% of cases, hypochlorhydria was present in the gastric juice. While some hold that the low red cell count and hæmo-

globin are due to a true anæmia existing in pregnancy, the trend of work in recent years has been to show that the low figures are mainly due to an increase in plasma volume or hydræmia.

Studies on iron metabolism in pregnancy show that the serum iron obtained by standard technique gives an idea of iron absorption and utilisation in the body. The serum iron level is thus an index of iron metabolism. Iron is bound with a protein in the serum which is identified as a beta globulin. The capacity of this beta globulin to bind iron is never fully taken up by the iron normally present in the serum. Hence there is present in the serum a variable quantity of beta globulin which is not saturated by iron. This unsaturated protein which can be estimated by standard techniques furnishes an estimate of the iron binding capacity of the serum. Thus by estimating the serum iron and iron binding capacity during pregnancy, it is possible to get a clear picture of the iron balance of the patient. Estimations of serum iron during pregnancy have however yielded differing results. It would appear however that there is a steady fall of the serum iron after the 20th week.

In a series of cases wherein the serum iron levels and iron binding capacity of the serum were determined, it was observed that the serum iron values were definitely lowered (average 75.8 micrograms—range 120-33 micrograms) and the total iron binding capacity definitely raised in pregnancy, especially in the last trimester (average 399.3 micrograms—range 278-644 micrograms).

Trends in Hæmatological Technique.—While iron and oxygen capacity estimations are the most accurate methods for estimation of hæmoglobin, they are too laborious for routine work, and so, colorimetric methods using a standard based on them are usually employed. A photo-electric colorimeter is used for this purpose. The percentage figure is read off in grammes per cent.

Another trend is to express all figures concerning blood counts as absolute values and the common absolute values in vogue are :—

$$1. \text{ Mean Corpuscular Hb. (MCH)} = \frac{\text{Hb. in gms. per 1000 millilitres of blood.}}{\text{R.B.C. in Millions.}}$$

The normal value is 29.5 micro-micrograms.

$$2. \text{ Mean Corpuscular Volume (MCV)} = \frac{\text{Volumes of packed cells per 1000 millilitres}}{\text{R.B.C. in Millions.}}$$

The normal is about 86 cubic microns. If it is over 90 it indicates macrocytosis.

3. Mean Corpuscular Hæmoglobin Concentration (MCHC)

$$= \frac{\text{Hb. in gms. per 100 ml.}}{\text{Volume of packed cell per 100 ml.}} \times 100$$

It is normally about 34%. It represents the actual hæmoglobin concentration in the blood and is the key to iron deficiency anæmia. The corpuscular volume or hæmatocrit reading is the volume of packed cells per 100 millilitres of blood. The normal is about 40%.

$$\text{The colour index} = \frac{\text{Hb. (percentage of normal)}}{\text{R.B.C. (percentage of normal)}}$$

It is normally about one. If it is less than one, the anæmia is hypochromic and if above one, it is hyperchromic.

Further Investigations. These include examination of the peripheral blood smear, reticulocyte count and an examination of a stained film of the bone marrow, which is an essential part of the study. The present tendency is to emphasise the type of bone marrow in anæmias and no study is complete without a bone marrow biopsy.

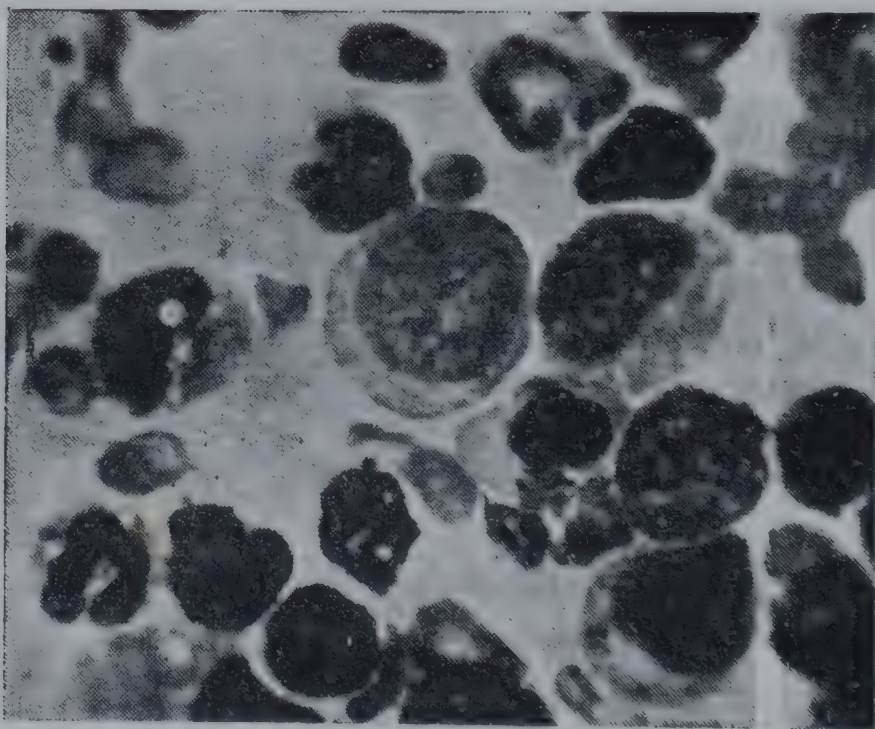


Fig. 55.—Bone marrow in a case of Megaloblastic anæmia

Other accessory investigations are :

Examination of the stools for ova.

Fractional test meal analysis.

Estimation of serum proteins.

Red cell fragility test.

Van den Bergh reaction.

Anæmia in Pregnancy

According to western standards a healthy pregnant woman should have a Hb-level of 11.5 Gm% (80%) or more. Levels below 11.5 Gm% is considered as anæmia. In India too, a well-to-do woman free from parasites and living on good diet should in pregnancy maintain her Hb level at a level comparable to her counterpart in the west. However a study of the so-called normal pregnant woman attending the hospital clinic has revealed that among the poorer class of people the average Hb level in normal pregnancy is about the order of 10.5 Gm%. Hence if western standards are adopted most of the pregnant mothers in the low socio-economic groups would be classed as anæmic. For practical purposes a Hb level below which the maternal and foetal prognosis is likely to be impaired has to be selected and every effort to maintain a Hb level above this should be made. For this purpose a Hb level of 8.7 Gm% (60%) could be accepted. Another critical level should be arbitrarily selected below which there is grave danger to life. These patients should be hospitalised and admission into hospitals obligatory. Experience has shown that persons with Hb levels of 6.5 Gm% (45%) or less are best hospitalised for investigation and treatment.

Another important problem posed by anæmia is its polymorphism. As is well known the common forms of anæmia result from deficiencies of iron, and the antianæmic factors folic acid and vitamin B₁₂. In the majority of cases the anæmia is caused by multiple factors (whose individual importance varies from area to area) which make rational prophylaxis and treatment much more difficult. From what has been stated it would be clear that it is extremely difficult to hazard a guess on the actual incidence of anæmia except to state that it is very common among those in the low income group and who live therefore on a poor diet. It would also be more common in a community who in addition is infected by parasites—malaria, hookworm—and who suffer from gastro-intestinal diseases like dysentery and diarrhœa.

A developing pregnancy tends to interfere with maternal erythropoiesis by competing for the available raw materials. However if a pregnant woman is in normal health eats a diet containing ample supplies of the essential materials and is free from parasites, these increased demands are readily satisfied and anæmia seldom develops. In areas where malnutrition, dysentery, malaria, helminthiasis are common, the majority of women if not actually anæmic are already depleted of the essential factors and are bordering on anæmia which rapidly develops as a result of increased demands of pregnancy.

The materials essential for erythropoiesis, deficiencies of which are mainly responsible for anæmia in pregnancy are broadly iron, folic acid and vitamin B₁₂. The deficiencies of these substances are

common and mixed deficiencies are also met with. As a result it is common to find in pregnancy not only iron deficiency anæmia but also anæmia due to deficiency of folic acid and/or vitamin B₁₂ in addition. Purely iron deficiency anæmia usually gives rise to a microcytic hypochromic anæmia with a normoblastic bone marrow while that due to deficiency of iron and folic acid or vitamin B₁₂ gives rise to macrocytic hypochromic anæmia with or without a megaloblastic bone marrow. Taking into consideration all cases with Hb level of less than 8.7 Gm% iron deficiency anæmia would appear to be more common while if only the severe cases are considered anæmia due to the combined deficiency (iron, folic acid/vitamin B₁₂) would appear to be more common. In a series of 325 cases studied in detail 35.5% were purely iron deficiency anæmia while the rest was due to deficiency of iron and folic acid/vitamin B₁₂. In the latter category the bone marrow was megaloblastic in 45%.

Iron deficiency anæmia (microcytic hypochromic anæmia).

As stated previously iron deficiency anæmia is very common in pregnancy. The iron deficiency may exist prior to pregnancy in which case pregnancy renders it worse or it may originate during pregnancy. There are many factors concerned in its production. First there is the pre-pregnant state of the patient, second the intake of iron in the food during pregnancy, third its absorption and utilisation and above all the demands of the fœtus. The iron requirements of pregnancy are moreover not confined to those of the fœtus alone. Additional iron is also required for the placenta, the enlarged uterus and for the increased blood volume that occurs in pregnancy—An estimate of the iron requirements is as follows :—

Iron content of the fœtus	400 mgm.
Placenta	100 „
Uterus	50 „
Hæmoglobin	320 „
	<hr/>
Total	870 „
	<hr/>

During the puerperium the iron stores may further suffer from blood lost in parturition. This is estimated to be about 175 mgm. and an additional 180 mgm. of iron will be required for milk production during a period of six months. Allowing for conservation of iron due to suppression of menstruation for ten months the estimated iron requirements for pregnancy and lactation would be about 800-1000 mgm. To meet this demand a pregnant woman would require to take about 20 mgm. of iron daily. The demands of the fœtus for iron become operative usually after the 20th week of pregnancy. It constitutes a searching test of the iron reserves of the mother and

her power to absorb fresh iron. If a woman has a good reserve her blood levels will fall only into the zone of latent deficiency. If her reserve is poor she will be precipitated into a manifest deficiency. The iron content of the diet of women in the poor socio-economic group is low. These women exist on a diet which gives them little opportunity to store iron and thus enable them to meet the demands of the fœtus when pregnancy supervenes. Iron deficiency anæmia may also arise from various other causes other than obstetric, namely from chronic malaria, malnutrition, ankylostomiasis, chronic blood loss due to bleeding piles, dysenteries and diarrhœa. When such women become pregnant the anæmia is rendered worse.

Iron deficiency gives rise to a microcytic hypochromic anæmia. It is more common in the multigravida than in the primi. The symptoms depend on the degree of anæmia. In the mild forms there may be few symptoms and the anæmia is detected in routine antenatal examination. The more severe forms give rise to pallor, breathlessness on exertion, œdema of the feet and face—sometimes massive œdema—at times diarrhœa and vomiting. The tongue is pale and flabby, the pulse is rapid, blood pressure normal or sometimes below normal, and in severe cases the patient is very ill. A number of cases have been seen with hæmoglobin levels below 2 grammes per cent and red cell counts of less than half a million. The blood picture is characteristic, microcytosis, anisocytosis, poikilocytosis and pale staining vacuolated red cell being found in abundance in the peripheral smear. The mean cell volume is below 80 cubic microns and the MCHC is well below normal, the colour index being much less than one. The bone marrow is normoblastic. In the majority of cases the fractional test meal shows hypochlorhydria. Examination of the stool may at times reveal a co-existing ankylostome infection. The anæmia often manifests itself in the second trimester—usually after the 24th week—and if untreated progressively gets worse.

Prognosis. In severe cases the prognosis is bad. Some patients die during pregnancy from myocardial failure. Premature labour may supervene which increases the hazards and gravely endangers the patient's life. The baby may die *in utero* from anoxia and from prematurity in the neonatal period : and in the puerperium the patient is more prone to infection. In some of the severely anæmic, pre-eclamptic toxæmia of even severe degree occur as a complication. This is more often seen in patients with ankylostomiasis and renders the prognosis worse.

Treatment. Too much emphasis cannot be laid on the need and value of repeated hæmoglobin estimations at the routine ante-natal examinations. The anæmia can then be spotted early and treated effectively. It is customary now to give all pregnant women iron by

mouth in some form or other, as a routine throughout pregnancy, as a prophylactic measure. Regulation and balancing of diet are essential. Foodstuffs containing iron should be taken in sufficient quantities.

As the anæmia is the result of iron deficiency, the treatment consists in the administration of iron. The aim of the treatment is to get the maximum benefit in the minimum possible time. Iron is usually given by mouth. The trend is to give ferrous salts, as they are found to be better absorbed and more effective. Ferrous sulphate, carbonate, fumarate and gluconate are all used in doses of 200 mgs. immediately after food three times a day. Dilute hydrochloric acid, one dram in a glass of water, three times a day along with food, helps in the absorption of iron and combats the hypochlorhydria present in these cases. The patient's diet must be corrected and balanced. Vitamins B and C are helpful adjuvants. The severe cases require hospitalisation and careful attention.

There are certain disadvantages in iron therapy by mouth. Firstly only a small percentage of the iron given is absorbed and utilised for hæmoglobin formation, secondly various factors interfere with its absorption and hence the results are slow and uncertain, and lastly large doses may give rise to gastro-intestinal symptoms. In severe cases there is often diarrhœa which prevents iron absorption. As a consequence of these uncertainties, attempts have been made to give iron parenterally. Iron preparations safe for intramuscular and intravenous use are available. The great advantage of intravenous administration is that almost all the iron given is utilised immediately in its elemental form. There are many preparations on the market.

Intravenous Iron Therapy. This is indicated in all cases of severe anæmia where a quick response is required, especially when the patient comes near term. It is the treatment of choice in patients who cannot tolerate iron by mouth or do not show satisfactory response to oral iron.

In the first and second trimesters with moderate degree of anæmia, oral iron might prove satisfactory. If, however, the anæmia is severe—with hæmoglobin levels less than 5 gms.%, parenteral iron therapy should be started whatever the period of pregnancy.

After determining the hæmoglobin of the patient, the total iron deficit in the body should be calculated. It has been shown that 25 mgm. of elemental iron will raise the hæmoglobin by 1%. Since iron administered intravenously is quantitatively converted into hæmoglobin, the amount of iron required to raise the hæmoglobin concentration to normal can be calculated. 100 mgm. of elemental iron raises the hæmoglobin by 0.55 gms./100 ml. From this formula,

the actual iron required for the patient can be determined. It is suggested that another 50% be added to raise the iron reserve in the body to normal. The calculated iron deficit is then administered intravenously to the patient according to the following dosage schedule which has been found satisfactory and safe : 1st day—50 mgm., 2nd day—100 mgm., 3rd day—200 mgm., and from then on every other day 200 mgm., till the total iron deficit is made good. The injections should be given slowly taking care not to infiltrate into the surrounding tissues. More than 200 mgm. at a time is not recommended as it is likely to give rise to severe reactions. Sometimes in some patients even with 200 mgm., reactions like vomiting, dyspnœa and collapse may take place. But this is rare. When it happens, it would be wise to reduce the next dose to 100 mgm., and prolong the interval from every other day to one in three days. On an average in the usual type of cases the hæmoglobin goes up by about 7 to 8% in a week. Congestive failure is a contra-indication to intravenous iron therapy.

Intramuscular Iron. Iron dextran complex—*Imferron*—is reported to be least toxic and to give good results when injected intramuscularly. Some have preferred *Imferron* to intravenous iron therapy. The dosage administered depends upon the severity of the anæmia—ordinarily 100-200 mgm. daily intramuscularly is the dosage adopted till the calculated iron deficit is made up. *Imferron* can be given intravenously also.

Iron Sorbitol Citric Acid Complex (Jectofer). This is yet another preparation of iron for intramuscular iron therapy. The active substance consists of iron sorbitol citric acid with dextran as stabiliser. 100 mgm. of Jectofer is given as deep intramuscular injection daily till the calculated total iron deficit is administered. In a series of cases so treated the response to treatment has been very satisfactory with an average increase in Hb of about 5-6 Gm% in three weeks time in the severe cases. Side reactions resulting from its use have been minimal and insignificant.

Total dose infusion. This is a more recent development in the treatment of severe iron deficiency anæmia. The deficit is first calculated and the total deficit in the form of Iron dextran diluted in 500 ml. of 5% glucose is given as a slow intravenous infusion. During infusion careful watch is kept for any untoward reactions. Occasionally rigors, chest pain and palpitation may be observed. When reactions are observed the drip should be stopped. If the iron deficit is large as in very severe cases, the total deficit may be divided into two doses and the infusions given on consecutive days. The improvement is quicker than when given by repeated injections and hospital stay can be reduced. But the patients require careful observation.

Anæmia due to deficiency of iron, Folic acid B₁₂ (macrocytic hypochromic anæmia with megaloblastic or normoblastic bone marrow).

As stated previously apart from iron, the materials essential for erythropoiesis are folic acid and vitamin B₁₂. These are consumed in food in a conjugated form and the active principles are liberated in the gastro-intestinal tract and absorbed. Deficiency of these factors in the food, improper absorption from the gastro-intestinal tract or its utilisation often give rise to a macrocytic anæmia. Similar anæmia may also occur in pregnancy if the increased demands for these factors during pregnancy are not met.

Estimation of serum B₁₂ and folate levels may demonstrate such deficiency. The following table gives the average and range of serum B₁₂ and folate values obtained in non-pregnant and pregnant women of the low socio-economic class.

Type	Serum B ₁₂ in micro-micrograms/ml.	Serum folate levels in milli-micrograms/ml.
Non-Pregnant	(51) 277.69 (84-560)	18.8 (3.5-45)
Pregnant	(48) 203.5 (62-380)	11.14 (1.5-33)

Statistical analysis of the data demonstrated a significant fall in both serum vitamin B₁₂ and folate levels in pregnancy when compared to that in the non-pregnant condition.

Estimation of the serum B₁₂ and folate levels in 100 cases of anæmia in pregnancy gave the following data :

Type	Serum B ₁₂ in micro-micrograms/ml.	Serum folate level in milli-micrograms/ml.
Pregnant (normal)	203.5 (62-380)	11.14 (1.5-33)
Pregnant (anæmia)	216.67 (48-440)	6.22 (1.2-33)

Statistical analysis revealed that the drop in serum folate level in anæmia was significant while there was no significant change in serum B₁₂ levels. It would appear that along with iron, folic acid deficiency is a major factor in the ætiology of anæmia in pregnancy.

Deficiencies of folic acid and vitamin B₁₂ give rise to macrocytic anæmia with or without megaloblastic bone marrow. If in combination an iron deficiency is also present—and this is very common—macrocytic hypochromic anæmia results.

The characteristic hæmatological features of this anæmia are mean cell volume of over 90 cubic microns and colour index less than 1. The MCH and MCHC are well below normal. A stained film shows macrocytes in abundance with anisocytosis and poikilocytosis. In severe cases normoblasts and at times megaloblasts are seen in the peripheral smear. In the majority of cases there is hypochlorhydria. The bone marrow in these cases may be either normoblastic or megaloblastic. The normoblastic marrow is more commonly seen than the megaloblastic variety.

Signs and Symptoms. These depend upon the severity of the anæmia. The disease makes itself evident between the twentieth and twenty-eighth week of pregnancy. In severe cases, the patient has a lemon yellow colour suggestive of Addisonian anæmia. She may complain of extreme weakness, breathlessness on exertion and occasional attacks of palpitation. The appetite is poor. The face is puffy and there is œdema of the feet with varying quantities of albumin in the urine. The tongue is sore in some cases. The heart is enlarged slightly and hæmic murmurs are present. The blood pressure is normal, but may sometimes be subnormal. In the severe types, signs of congestive failure may be present. The liver and spleen are not notably enlarged.

The disease takes a progressive course until death supervenes or in some cases spontaneous improvement occurs in the puerperium. Labour generally sets in prematurely and is precipitate. During labour there is often a blood crisis, characterised by an increase in the number of megalocytes, normoblasts, myelocytes and reticulocytes in the blood, associated with cyanosis, dyspnœa and rapid pulse. The patient's condition becomes much worse immediately after parturition. In fact this period seems to be the most critical as with the birth of the child, the breathing becomes more laboured, hypernœa and dyspnœa develop, the patient becomes comatose, and expires. Even if the patient survives the shock of labour, the first few days of the puerperium are critical.

Prognosis. The prognosis is grave for both the mother and the child. In fact, at present, anæmia accounts for nearly 20% of maternal

deaths and in another 20% it is an associated factor. Premature labour and intra-uterine anoxia increase the hazards to the fœtus. If, however, the anæmia is treated effectively early in pregnancy, the prognosis improves.

These patients improve rapidly once the delivery is over and they survive the critical days of the early puerperium. The babies born of these mothers are seldom anæmic at birth, their average hæmoglobin being 17.5-18.5 gms.% but they develop anæmia later.

Treatment. The best method is to prevent the development of any severe degree of anæmia, and for this, spotting the anæmia early by efficient ante-natal care is the only remedy.

Once the anæmia develops and its type is recognised by detailed hæmatological examination, treatment consists in the administration of various hæmatinics.

The aim in the management of these cases should be to obtain the maximum hæmoglobin level as quickly as possible.

If the anæmia is not severe, iron and folic acid orally would suffice. 200 mgms. of Ferrous sulphate three times a day with 5 mgms. of Folic acid. On the other hand if the anæmia is severe parenteral iron—administered as already described—along with 5 mgms. of Folic acid orally or parenterally daily would give satisfactory results. Where B₁₂ deficiency is suspected iron therapy would need supplementation with 50-100 micrograms of B₁₂ orally or parenterally.

One of the factors which retards response to treatment is hypoproteinæmia. A large majority of cases have very low serum proteins and hence proteins should be given to these patients—increased amounts in food—or as protein hydrolysate by mouth. It helps in obtaining speed in response. The diet must be balanced and adjusted.

Blood Transfusion.

Blood transfusion suggests itself as an obvious method of treatment in cases of severe anæmia. It may be so in the non-pregnant condition. But in pregnancy the situation is different. There is increase in blood volume and anæmia is not the result of hæmorrhage. Hence blood transfusion in pregnancy for anæmia is not safe as by overloading the circulation it may precipitate cardiac failure. If the patient is already in failure—as most of the very severely anæmic are—transfusion can be dangerous. When blood transfusion is chosen as the method of treatment it should be given only in small amounts—150-250 ml. and slowly. Packed cell transfusion is safer and more beneficial. However the improvement is slow.

It has been observed that with low Hb levels—less than 2.5 G% and PCV less than 15% congestive failure is always present. Maximum number of deaths from anæmia during pregnancy and labour has occurred in this group. Intravenous iron therapy is not without danger in these patients and intramuscular iron is slow in response. Blood transfusion is dangerous. If packed cells could be administered in large quantities sufficient to produce rapid improvement and without increasing the blood volume and the load on the heart it would be possible to save some lives.

For this purpose exchange transfusion is exceedingly useful. 600-800 cc. of blood is withdrawn from one vein while through an opposite vein simultaneously 500-600 cml. of compatible packed cells are given. The withdrawal avoids the extra load on the circulation and the fresh red cells containing more Hb is made available rapidly. The results of the treatment has been most gratifying. Within 24 hours marked improvement in the general condition of the patient is noticeable and after this, the conventional forms of treatment of anæmia is continued. Among 105 cases treated with exchange transfusion only 2 mothers were lost. Reactions have been minimal and not serious.

The table below shows the response to treatment compared to parenteral iron therapy.

	Initial		48 hrs.		1st Wk.		2nd Wk.		4th Wk.	
	Hb	PCV	Hb	PCV	Hb	PCV	Hb	PCV	Hb	PCV
Exchange transfusion	2.5	12	4.4	19	5.6	23	6.8	27	8.8	33
I.V. Iron	2.8	12	—	—	3.6	16	5.4	23	6.8	28
I.M. Iron	2.7	12	—	—	3.7	17	5.7	21	6.3	27

It is pointed out that exchange transfusion is not to be employed as a routine in all cases. It is only a treatment of extreme urgency and utmost necessity. Its main value is to obtain an immediate response to tide over a dangerous crisis and help to keep the patient alive till conventional forms of therapy begin to take effect.

The Management of Labour. It is an anxious and worrying problem. Labour is usually quick in the severely anæmic. If however it is not, the second stage is best cut short by outlet forceps under pudendal block anæsthesia. Post-partum hæmorrhage is uncommon, but even so these patients cannot afford to lose even the normal amount of blood in the third stage. Hence, as a routine,

it is better to give Methergine 0.25 mgm. intravenously at the time of the delivery of the head, so as to minimise the blood loss. In the very severe cases circulatory collapse might occur after delivery and one must be prepared to meet this eventuality with oxygen, digitalis and stimulants. Even after survival of the critical first days of the puerperium, the risk of puerperal infection is present and in the late puerperium thrombophlebitis occurs more commonly in these patients than in others. Convalescence is often prolonged.

Prognosis. In severe cases, the prognosis is grave for the mother and very poor for the fœtus. 20% of our maternal deaths are from anæmia and in another 20% it is an associated factor. For the fœtus, the prognosis is poor because of prematurity, as most of the severe cases go into premature labour. If however patients are examined early and treated efficiently the prognosis certainly improves.

At times cases are seen which do not respond to any treatment and sometimes the patient's condition gets even worse. It is a great temptation under such circumstances to terminate pregnancy. This temptation should be resisted. Nothing can be more dangerous than terminating pregnancy in a patient with severe anæmia. Induction of premature labour has no place in the management of these cases.

The problem of anæmia is intimately connected with poor socio-economic conditions and malnutrition. Its control and eradication is an urgent necessity. From field trials carried out in the prevention of anæmia sufficient data is available indicating that administration of 0.5 mgm. of folic acid and 200 mgm. of ferrous sulphate daily to all pregnant women from the early trimester will help in reducing to a very large extent the incidence of the severe varieties of anæmia in pregnancy.

Various other types of anæmia also may be seen as a complication in pregnancy. Women suffering from anæmia due to chronic malaria, kaia-azar, bleeding piles and gastro-intestinal diseases may become pregnant. Hæmolytic anæmia, aplastic anæmia and Addison's anæmia also may be seen in association with pregnancy. These can usually be diagnosed from the history and laboratory investigations. It is not proposed to go into the details of investigations, diagnosis and treatment of these anæmias except to state that the occurrence of pregnancy in such women is only an added indication for adopting rapidly effective methods of treatment to obtain the best results for mother and child.

HELMINTHIASIS

Hookworm Disease. Hookworm disease, or ankylostomiasis, is very common in tropical and subtropical countries and is one of the most common causes of chronic invalidism, of mental and physical inertness and not infrequently of death. Its greatest danger appears to be when it occurs as a complication of pregnancy. The disease is due to the worms attaching themselves firmly to the mucosa of the duodenum and the small intestines, feeding on blood and causing local bleeding resulting in anæmia. Toxins are also probably produced by the parasites which depress the erythroblastic activity of the bone marrow. There are two common forms of the hookworm—the *Ankylostoma duodenale* and the *Necator americanus*.

When the infection has taken place, and particularly if it is heavy, symptoms may appear within one or two months. These are largely related to the anæmia, which is of the secondary type, associated with a low colour index. Mild cases may be symptomless; but in the moderately severe cases, mental and physical lethargy, hyperacidity, epigastric tenderness, palpitation and shortness of breath are present. In the more severe type there may be a discoloration of the skin, which is dry and muddy in colour. Pallor of the mucous membrane is particularly marked. The pale, flabby tongue, combined with the general puffy appearance of the face and its muddy complexion, give a striking picture of this condition. The veins of the neck may be pulsating and hæmic murmurs are common. Retinal hæmorrhages, œdema of the feet and serous effusions may also occur.

Diagnosis. The disease can be easily diagnosed by the characteristic clinical picture and confirmed by examination of the stools, which will show the typical ova, especially if the flotation method is adopted.

Influence of Hookworm Diseases on Pregnancy, Labour and Puerperium. This disease has a very adverse effect upon pregnancy. Abortion, premature birth and stillbirths being common occurrences, especially in the neglected or untreated cases. These patients at times develop severe pre-eclamptic toxæmia as evidenced by high blood pressure, massive albuminuria and œdema.

During the puerperium, owing to the low vitality of the patient, the incidence of puerperal sepsis is greater.

Prognosis. The prognosis depends upon the severity of the resultant anæmia. The longer the patient has been under treatment and the greater the improvement in her general condition, the better

are the chances of her survival. The onset of pre-eclamptic toxæmia makes the prognosis worse.

The prognosis for the child is also unfavourable. The tendency for premature delivery and greater incidence of pre-eclamptic toxæmia makes the prognosis more unfavourable for the child.

Treatment. In all areas where ankylostomiasis is prevalent, women in the early months of pregnancy should be given anti-hookworm treatment if necessary. Where there is widespread hookworm infection, the need for mass treatment need hardly be emphasized. A routine hæmatological examination at the antenatal clinic of all pregnant women at any stage of pregnancy has already been referred to.

When the anæmia has been definitely diagnosed as due to hookworm, the treatment should be started at once. Pregnancy is no contra-indication. The fear that abortion will follow as a result of the treatment is groundless.

If the patient is severely anæmic, it would be advisable to treat the anæmia first so as to bring the hæmoglobin level to at least 6 G%. These patients do not tolerate iron by mouth and hence parenteral iron or blood transfusion will have to be resorted to in the very severely anæmic. Intramuscular iron—Imferron 100 mgm. daily intramuscularly—could be used. Packed cell transfusion is the alternative. The anæmia is slow to improve till the worms are cleared out. For this Tetrachlorethylene is preferable in pregnancy to oleum chinapodium or carbon tetrachloride. Three ml. of Tetrachlorethylene in a capsule is given early morning on an empty stomach after a fasting night, followed by four to six drams of magnesium sulphate in two or three ounces of water two hours later. Only light diet should be given to the patient for the next twenty-four hours. A week after the treatment, the motion should be repeatedly examined for ova and, if found, another course of treatment should be given a fortnight after the first course. A better method of treatment is to administer orally Bephenium hydroxynaphthoate (Alcopar) in a single dose of 5 gm. repeated in a week if necessary. Most cases respond. The treatment for anæmia must be continued, and once the worms are got rid of, the anæmia improves quickly. Pregnancy must not be interfered with at any time. In labour it is advisable to cut short the second stage by outlet forceps under pudental block anæsthesia. In the puerperium, infection is more likely to supervene in these cases.

At times severe pre-eclampsia complicates the situation. Simultaneous treatment of the toxæmia on medical lines should be persisted in. Many respond to treatment. In some the toxæmia does not

improve nor the anæmia. It is hazardous to terminate pregnancy in the severely anæmic. So long as the danger of eclampsia is not imminent, it is safer not to terminate pregnancy. Should however imminent eclampsia be evident, one will be forced to terminate the pregnancy by artificial rupture of the membranes. The prognosis is extremely grave under the circumstances. Fortunately, in these cases, while the obstetrician is hesitating, premature labour sets in and saves the obstetrician from the dilemma.

DISEASES OF THE URINARY SYSTEM

Bacteriuria in pregnancy. Obstetricians have been aware for many years that about 5-10% of pregnant women were liable to have large number of bacteria in the urine in the absence of symptoms. In 90% the organism found is *E. coli*. Later work demonstrated that pyelonephritis of pregnancy developed in 40% of women with bacteriuria but was very uncommon in those without bacteria in the urine. It has been shown that by detection and effective treatment of asymptomatic bacteriuria in early pregnancy the risk of subsequent pyelonephritis could be virtually eliminated.

Apart from the danger of pyelonephritis it has been suggested that other complications of pregnancy may be associated with it; as for example increased prematurity rate and foetal mortality rate are found to be associated with bacteriuria of pregnancy. It would seem therefore that detection and treatment of bacteriuria should be an essential part of antenatal care.

The diagnosis of asymptomatic bacteriuria requires the demonstration of a significant number of bacteria in the urine. In most instances it can be accomplished by culturing midstream voided specimens of urine without resorting to catheterisation. When quantitative methods of culturing urine are used a midstream specimen of urine containing more than 5/10 organisms (10,00,000) per millilitre of urine is usually indicative of infection and even though asymptomatic it would be advisable to eradicate the infection by treatment with antimicrobial agents.

Pyelitis of pregnancy was a term which has been used to describe infection of the urinary tract in pregnancy. It is now realised that almost always where the pelvis of the kidney is involved the renal parenchyma is also involved and therefore the term Pyelitis is a misnomer. The correct terminology is Pyelonephritis. While acute pyelonephritis is common in pregnancy, infection of the bladder alone—cystitis—may also be met with though less frequently.

CYSTITIS

Cystitis results from bacterial infection of the bladder. It is more often seen prior to the 16th week of pregnancy in women with marked retroversion of the gravid uterus. As a result of such retroversion

the cervix may get hitched under the symphysis pubis occasionally compressing the urethra. The anatomical changes resulting from the displacement gives rise to obstruction to the free flow of urine as a result of which stasis results and infection follows. At times the obstruction and infection is severe as a result of impaction or incarceration of the gravid uterus within the pelvis. This may necessitate termination of pregnancy.

The examination of the urine helps in the diagnosis—red blood cells, pus cells and bacteria are all present in the severe forms with characteristic symptoms of dysuria and attacks of retention of urine. Treatment consists in antimicrobial therapy and correction of the retroversion. It may in some cases be necessary to drain the bladder continuously for a few days.

Cystitis may also occur in patients with uterovaginal prolapse and pregnancy.

ACUTE PYELONEPHRITIS

Acute pyelonephritis is one of the most common complications of pregnancy and puerperium. The incidence of this complication is approximately 2%. The disease is often bilateral but is predominantly right-sided when unilateral. It more frequently appears after the 20th week of pregnancy.

Several factors predispose the pregnant woman to acute pyelonephritis. As a result of the hormonal changes of pregnancy as well as the mechanical effect of the enlarging uterus there is a gradual dilatation of the renal calyces, pelvis and tortuosity and kinking of the ureters accompanied by a decrease in ureteral muscular tone and peristalsis is more marked in the primigravida and on the right side. These changes produce a physiologic obstruction to urinary flow which promotes infection.

Acute pyelonephritis is the result of bacterial infection which may extend upwards from the bladder or through the blood vessels and lymphatics. The weight of clinical evidence suggests that ascending infection from the bladder via the ureters to the kidney is the more common route. The urine in the bladder is normally sterile. During pregnancy the major causes of infection of the bladder are asymptomatic bacteriuria and catheterisation of the bladder.

The common organism concerned in the infection is *E. coli* in 90% of cases. Among other organisms may be mentioned streptococci, staphylococci, typhoid and paratyphoid group of bacilli.

Signs and symptoms. The onset of the disease is usually rather abrupt with fever, chills and aching pain in one or both costovertebral areas. Anorexia, nausea and vomiting may be present. The temperature is usually raised above 101°F and tenderness in one or both loins in the region of the kidney can be elicited. The urine contains pus cells and on staining the sediment numerous bacilli can be demonstrated. In the early stages renal function is not impaired. Occasionally dysuria and hæmaturia may precede the attack.

Diagnosis. In the acute stage of the disease pyelonephritis may have to be differentiated from Malaria, acute appendicitis and occasionally enteric fever. The fever with rigor may stimulate an attack of Malaria in areas where Malaria is prevalent. Examination of the blood and urine will help to clinch the diagnosis. Enteric fever can be ruled out by blood culture in the early days and by Widal reaction later. The presence of pain and tenderness over the right lower abdomen may simulate an attack of acute appendicitis. A careful physical examination and examination of the urine will help in differentiation. Occasionally appendicitis and pyelitis may co-exist.

Treatment. Various drugs are now available for the treatment of urinary infection. It would be wise to test the sensitivity of the infecting organism to the antimicrobial agents.

All patients with acute symptoms should be nursed in bed on general lines. Broad spectrum antibiotics according to the sensitivity of the organism should be administered. The common antibiotics employed are Streptomycin 1 gm. daily for 5-6 days, Tetracycline and chloramphenicol—250 mgms. three to four times a day for 5-6 days. In severe cases it would be advisable to continue the therapy for at least ten days. Nitrofurantoin is another useful drug in the treatment of urinary infection—100-150 mgms. orally daily for 5-7 days would be sufficient ordinarily.

Antimicrobial agents may produce undesirable side effects in mother and the foetus. Sulphonamides pass the placental barrier and large doses administered to the mother late in pregnancy have been reported to cause kernicterus in the new born infant. Tetracycline administered in the last trimester of pregnancy may cause discolouration of the deciduous tooth of the infant. Chloramphenicol may produce aplastic anæmia and thrombocytopænia in the mother while nitrofurantoin also may at times give rise to hæmolytic anæmia. Hence it is essential to use the drugs with caution.

Most urinary infections respond readily to adequate antimicrobial therapy. Symptoms disappear in 48-72 hours and culture becomes sterile in 24 hours. But the physiological changes in the urinary

tract are unaltered by treatment and so reinfection and recurrence of symptoms during pregnancy and puerperium are common. At times though rarely under modern management the renal parenchyma becomes badly damaged as demonstrated by abnormal renal function and rising blood urea. When it happens pregnancy will have to be terminated. Premature labour also is an occasional event in the acute stage of the disease. It is one of the factors in low birth weight of infants which enhance perinatal mortality.

Pyelonephritis in pregnancy must not be considered cured unless the urine remains sterile on repeated examination. Although most patients who develop urinary infection during pregnancy may never have significant renal damage at least some patients develop serious renal disease—chronic pyelonephritis and later renal failure. It is therefore imperative to treat all urinary tract infections in pregnancy adequately.

Chronic Pyelonephritis complicating pregnancy. Women suffering from chronic pyelonephritis may become pregnant. Its diagnosis from pre-eclampsia is made possible by a history of pre-existing renal disease, the presence of all varieties of casts in the urine, albuminuric retinitis and in advanced cases increased blood urea and abnormal renal function tests. The same findings help to differentiate it from hypertension complicating pregnancy.

The prognosis. The outlook for a successful pregnancy is poor if the disease is of a severe degree as shown by high blood urea, high blood pressure and retinal changes. To the mother it is often unfavourable. Fifty per cent of them become definitely worse as a result of pregnancy. Notwithstanding a rather favourable outcome in about half the number of cases pregnancy in a patient with even mild chronic pyelonephritis should be considered a serious risk.

Management. It is safer not to allow pregnancy to continue in these patients. In severe cases the pregnancy should be terminated. In milder cases the patient should be advised termination of pregnancy. If however the pregnancy is allowed to continue there may be a 50% chance to the foetus. Strict supervision will be required in the antenatal period and the patient is best hospitalised. The babies in these cases are usually smaller than normal even at term due to placental insufficiency. Many advocate caesarean section at 38th week as intrauterine death is common.

Acute renal failure in obstetric practice.

Renal failure clinically evidenced by extreme degree of oliguria terminating in anuria may be met with in a variety of conditions in pregnancy. The more important ones are (1) Eclampsia, (2) Severe

varieties of accidental hæmorrhage especially the concealed variety, (3) Traumatic delivery, (4) Severe postpartum hæmorrhage, (5) Septic abortion. It may also occur as a result of injection of substances into the uterine cavity to produce abortion, mismatched blood transfusion, sulphonamide therapy or acute adreno-cortical failure. When pregnancy occurs in women with pre-existing renal disease like acute or chronic glomerulo pyelonephritis renal failure is more likely to occur.

The usual kidney lesions found on postmortem in those who die of renal failure are bilateral cortical necrosis of the kidneys or acute tubular necrosis (lower nephron nephrosis).

There is some controversy regarding the ætiology of these lesions. It is thought by some that renal ischæmia causes both cortical necrosis and lower nephron nephrosis and that the difference is only one of degree. Vasoconstriction of the afferent glomerular capillaries which diminish the blood supply to glomeruli and tubules is the main feature. The tubules suffer damage and degenerate first. If the vasoconstriction passes off early, both tubules and glomeruli recover but if it persists thrombosis of the vessels occurs and cortical necrosis results.

Another theory suggests that toxic products released into the circulation reach the kidney and cause either irreversible damage to the afferent glomerular arterioles resulting in cortical necrosis or else the toxins damage the tubules by gaining access through a medullary shunt of the blood (Trueta shunt) resulting in tubular necrosis.

Whatever be the mechanism and lesions the clinical picture is the same. The first warning of renal failure is the extremely small quantities of urine obtained on catheterisation—often only a few millilitres. There may be also a transient hæmaturia and anuria follows. It is seldom that patients survive bilateral cortical necrosis. Survival is not uncommon in those with tubular lesions and in such patients the blood urea may continue to rise sometimes reaching very high levels like 560 mgm.% as in one of our patients who survived. Diuresis may start usually within a week to ten days and the patients recover. In the fatal cases the patients remain alert and cheerful and relatively free from symptoms until about the 7th to 10th day when coma sets in as a result of uræmia and death ensues. Hyperkalæmia is often seen in these cases.

Schwartzman reaction in pregnancy and renal failure:

In 1937 Schwartzman described a reaction in pregnant patients associated with shock and anuria. This reaction was also experimentally produced in animals by a variety of bacterial endotoxins. In animal experiments if a sensitising dose of endotoxin given intra-

venously is followed by another provocative dose, profound shock is found to develop and disseminated intravascular coagulation with the appearance of thrombi in the renal glomerular capillaries are found on postmortem. In pregnancy however such a reaction can occur even without a sensitising dose of endotoxin. This has been shown experimentally in pregnant animals. During pregnancy intrauterine infection may give rise to an endotoxin which may enter the blood stream and give rise to this reaction. The patient may in such cases die of profound shock. Coagulation failure may occur as a result of extensive intravascular thrombosis using up all available fibrinogen. The most characteristic feature however is thrombosis of the afferent glomerular capillaries resulting in anuria and bilateral renal cortical necrosis.

Treatment of renal failure

Carbohydrate is essential to minimise protein catabolism. The basic daily requirements are met by four bottles of HYCAL (flavoured liquid dextrose concentrate) which provides 1700 calories with 400 ml. of water. Caloreen is a useful alternative for patients who find Hycal unpalatable. For those who are unable to take fluids orally because of nausea or vomiting an intragastric drip of 600-700 ml. of water containing 100-400 gm. of glucose in 24 hours may be given. Potassium intoxication can be corrected by the intravenous injection of 100 mEQ of Sodium Bicarbonate.

It is necessary to estimate daily the blood urea and serum electrolytes. A daily rise of more than 60 mgms/100 ml. of urea indicates a hypercatabolic state and in this state hyperkalæmia and acidosis may develop with alarming rapidity. Such patients are best dealt with by peritoneal or hæmodialysis in special units.

DIABETES AND PREGNANCY

DURING pregnancy the presence of sugar in the urine is not infrequently demonstrated by any of the ordinary tests such as Fehling's or Benedict's. The presence of sugar, however, does not necessarily indicate the presence of true diabetes. As a matter of fact, the occurrence of glycosuria in pregnancy may be due to several causes, namely,

- (1) An innocent form of glycosuria due to diminished sugar tolerance in pregnancy.
- (2) A lactosuria due to hyperfunction of the breasts.
- (3) Disturbances of the endocrine system.
- (4) True diabetes mellitus.

It is of importance to differentiate these conditions and to establish definitely whether true diabetes is present or not. This can only be done by a glucose tolerance test and the study of the blood sugar curve.

Prior to the advent of insulin, pregnancy in a diabetic was rare. Since then pregnancy occurs more frequently. In 20,000 deliveries the incidence of diabetes complicating pregnancy has been 6 or .03%.

Diabetes may manifest itself for the first time in pregnancy or much more commonly a diabetic woman may become pregnant. Usually diabetes is a disease of later life, which might account for the low incidence of the complication in pregnancy. However diabetes may also occur in the younger age group, when it is usually very sensitive to insulin. The patients are rather thin and tendency to ketosis is more marked. In the older age group the patients are more on the stout side, there is little tendency to ketosis and diabetes may occasionally be insulin resistant. Pregnancy can occur in both these types, but more often it is seen in the latter type.

The Pre-diabetic State. An enquiry into the previous obstetric history of pregnant women with established diabetes often reveals a very suggestive picture. Many give a history of having delivered unusually large babies, many of whom were still-born or died soon after birth. The total foetal loss including abortions in this group is much greater than in a normal group. The combination of large babies, a high rate of foetal loss, a tendency to hydramnios and toxæmia, should act as a warning of the possible development of diabetes

in later life. A glucose tolerance test may show a lag curve but not a true diabetic one. To this the term pre-diabetic state is applied.

Effect of Pregnancy on Diabetes. The insulin requirement of the patient during pregnancy increases. It starts to increase from about the third month until term. Because of the constantly changing insulin requirement, unless a patient is carefully watched during pregnancy ketosis is likely to develop more easily. There is no evidence that foetal insulin helps the mother to reduce her requirements.

There is often a lowered renal threshold in pregnancy which is more common in diabetics. It clears up in the puerperium. This lowered renal threshold makes repeated blood sugar estimation imperative in the control of diabetes in pregnancy. Retinal changes if present may be aggravated by the pregnancy. Diabetic coma, however, is rare.

The Effect of Diabetes on Pregnancy. It has often been stated that diabetes is a cause of abortion. But evidence for this statement is lacking. The average incidence of 10.9% of abortions reported in a series of diabetics is in no way greater than in a group of normal pregnant women.

The most striking effect of diabetes on pregnancy is the extremely high foetal loss. This is mostly due to intra-uterine death, still-births and neonatal deaths. In neglected cases foetal mortality ranges from 20% to 60%. Other factors found in association are the marked increase in the incidence of pre-eclamptic toxæmia, hydramnios, excessive size of the baby and congenital anomalies of the foetus.

Factors Influencing Foetal Death. The exact cause of foetal death *in utero* is not known. But the diabetic mother is more prone to certain complications which endanger the foetus. These factors are discussed below :

Pre-eclamptic toxæmia. The average incidence of pre-eclamptic toxæmia in normal patients is between 10-12%. In diabetes the incidence ranges from 20-60%, especially if the pregnancy is continued beyond the 36th or 37th week. It was therefore thought that the main cause of intra-uterine death was the onset of toxæmia. However even when pregnancy is terminated in diabetic women at the 37th week before the onset of toxæmia, the foetal mortality remains high indicating that toxæmia is not the sole factor in causing intra-uterine death. It is also seen that toxæmia is not related to the severity of diabetes.

Hydramnios and congenital anomalies are found more frequently in diabetics. In association with hydramnios is also seen larger babies, greater incidence of toxæmia and increased foetal loss. Neither the mother's mean blood sugar level during pregnancy, nor the child's blood sugar is found to have any relationship to the hydramnios.

Ketosis in the mother, even without coma, is particularly dangerous to the foetus. But it is doubtful whether it can be made to account for the very large number of foetal deaths. No direct relationship to the foetal loss and severity of diabetes has been observed. Even in well controlled cases there is a very high foetal loss ranging from 15% to 30%, thus pointing to some factor other than ketosis as the cause of intra-uterine death.

Hormonal Imbalance. Smith's study showed that the serum chorionic gonadotrophin was raised while the steroid hormone values, oestrogen and pregnandiol in urine, were lowered. It was believed that the increase in chorionic gonadotrophin was due to the inability of the placenta to utilise the hormone for the synthesis of the steroid hormones as occurs in normal pregnancy. From this it was inferred that, if Stilboesterol was administered to these patients, it might stimulate the utilisation of the chorionic gonadotrophin and produce more oestrogen and progesterone thus increasing the vascularity of the uterus. Smith's hypothesis was confirmed by White, who found the incidence of toxæmia was 50% and foetal survival rate 44% in a series of cases wherein the hormonal changes found by Smith were present. In another series where the hormonal imbalance was not existent, the foetal survival rate was 97% and the incidence of toxæmia was low.

A number of babies are lost during delivery. 18-20% is the average fresh still-birth rate. A certain percentage of these deaths is due to obstetric difficulties because of the large size of the child, but quite a large number of deaths in labour are unexplained.

The cause for the production of large-sized babies has been a matter of controversy. More than 50% of babies weigh more than 7 lb. even by 36 weeks. There is œdema of the skin and subcutaneous tissues. It was thought that a raised maternal blood sugar might account for the large babies born of diabetic mothers. But in pre-diabetes, where also large babies are common, the maternal blood sugar is normal. The association of maternal obesity, large babies, a high rate of foetal loss and the subsequent development of diabetes has recently been explained by suggesting that there is an excessive production of the diabetogenic and growth producing hormones of the anterior pituitary. In pregnancy the dysfunction of the anterior pituitary may be the cause of diabetes and overgrowth of the foetus.

Neonatal deaths occur very commonly in babies of diabetic mothers. These deaths are common even in those delivered by cæsarean section. Prematurity and the diabetic state would seem to be the important predisposing factors. As the baby becomes less premature, the neonatal deaths would seem to decline. The large size of the babies born would seem to offer no safety to them so long as prematurity to term remains. It has been suggested that the cause of death may be hypoglycæmia in the infant resulting from the excessive production of

insulin by the foetus in response to the high content of sugar in the mother's blood. There is however no proof for this suggestion, for the insulin requirements of the mother would seem to increase in pregnancy. The normal blood sugar range of 25-60 mgm. in normal infants is also seen in babies born of diabetic mothers.

Large amounts of fluid are contained in the stomach of babies of diabetic mothers. It is possible that regurgitation from the stomach leads to pulmonary complications and death in the neonatal period. Pulmonary hyaline membrane is more often seen in babies of diabetic mothers.

The Diagnosis of Diabetes in Pregnancy. This is usually made on routine examination of the urine when the presence of sugar puts the obstetrician on guard. Lactosuria during pregnancy is less common than glycosuria, but it should be borne in mind that in all cases where glycosuria is seen, a glucose tolerance test should be done to rule out low renal threshold and to establish a definite diagnosis of diabetes. A raised, fasting blood sugar is also indicative of diabetes.

The Management of Pregnancy and Labour. Strict control of diabetes during pregnancy is essential. For this frequent examination of the patient is imperative. As the pregnancy advances the insulin requirements usually increase. Ketosis may set in unless the increasing requirements of insulin are met. Frequent blood sugar studies may be necessary in severe cases. Routine antenatal examination should be thorough. The obstetrician should always be on the look-out for the onset of pre-eclamptic toxæmia. Eye grounds must be examined frequently. The patients should be seen at least once a week after the 20th week and fortnightly prior to it. The diet should be controlled. The urine should be examined daily for sugar and acetone and the dosage of insulin adjusted accordingly. Blood sugar estimation should be done occasionally and whenever in doubt. The calorific value of the diet should be about 2000 calories of which carbohydrates should form 200-250 grams. Fats should be reduced. The case must always be treated in consultation with an internist.

The value of hormones in the management of diabetes in pregnancy is disputed. White has reported excellent results from the use of stilboesterol and progesterone intramuscularly in cases showing hormonal imbalance.

All patients must be hospitalised at the onset of hydramnios and toxæmia and, even in their absence, by the 36th week. There is no general agreement about the time for delivering the patient who has reached the 36th week without any complication. There are many who believe that such cases may be permitted to go into spontaneous

labour at term in the belief that in the absence of any complications when the diabetes is well controlled, the fœtus gains more by being mature when it is born. It has also been our experience that in well controlled diabetes, with no toxæmia or hydramnios, one could wait for the spontaneous onset of labour instead of interfering especially in patients with good obstetric history. If on the other hand there is a history of previous intrauterine death or neonatal death it would be wiser to terminate pregnancy by 38 weeks even if the diabetes is well controlled.

The babies being big in these cases, there are many who prefer to deliver all cases by cæsarean section. We believe that cæsarean section in these uncomplicated cases need be resorted to only when examination indicates a prolonged labour. Especially in multigravida, where examination reveals a soft and dilatable cervix and an engaged head, vaginal delivery could be resorted to. In a primigravida with unengaged head and cervix not well effaced, cæsarean section would be the treatment of choice.

Termination of Pregnancy. In well controlled diabetes with no complications, it is not very necessary to terminate pregnancy after the 36th week and most of them could be permitted to go to term and await spontaneous onset of labour. Cæsarean section would be necessary only on obstetric indications.

In cases where toxæmia has supervened, or retinitis is observed and diabetes is not well controlled, cæsarean section after the 34th week offers the best chance for the fœtus. In those with well effaced cervixes and engaged head, induction by artificial rupture of the membranes would be the line of management.

During labour the patient must be carefully watched. Urine should be frequently tested for acetone, and if present, controlled by insulin and intravenous glucose. Prophylactic antibiotic therapy is indicated. Blood sugar estimations are helpful.

For cæsarean section spinal anæsthesia or local infiltration is advocated. A continuous intravenous drip of 5% glucose with insulin administered, when necessary, is of value. The urine should be examined every 2-4 hours for sugar and acetone and the insulin dosage adjusted accordingly.

All babies born of these mothers either vaginally or by cæsarean section should have their stomach aspirated and be treated as premature, if delivered before term, in spite of their weight. They require special care. It is better not to give fluids to the new born baby because of fluid retention in the tissues and to start feeding on

the third day. Hypoglycæmia is not so important and the value of giving glucose as a routine to these babies is doubtful, except when the blood sugar is below 25 mgm. %.

In the puerperium the insulin requirements of the mother decrease and care should be taken to avoid hypoglycæmia. Breast feeding is often a failure. The predisposition in these patients to infection must be borne in mind.

OTHER DISEASES COMPLICATING PREGNANCY

Malaria

IN endemic areas Malaria may occur as a complication in pregnancy. It may alter the course of pregnancy both by affecting the health of the mother and by interrupting pregnancy. As a result it may be responsible for maternal deaths and more commonly for foetal loss. Apart from the increase in frequency and severity of attacks of malaria during pregnancy it produces significant deterioration in maternal health by causing anæmia which may at times be very severe. In such severely anæmic patients labour is of grave significance. In the puerperium latent infection may flare up and it may also be an occasional cause of puerperal pyrexia. Unless the patient is gravely ill with anæmia, malaria usually does not interfere with lactation.

Malaria may cause termination of pregnancy by precipitating abortion or premature labour. It may interfere with the growth of the foetus and also cause intra-uterine death. Transplacental infection of the foetus occasionally occurs. The high fever due to malaria is most often the cause of abortion or premature labour or intra-uterine death. In cases of severe infection there is found in the placenta massive infection with parasites. These parasites interfere with the circulation of blood through the intervillous spaces which impairs the growth of the foetus.

Benign forms of malaria may not give rise to complications in the mother or infant unless the infection is very heavy. Most complications result from the malignant variety.

Thanks to extensive malaria eradication programmes carried out with the help of the World Health Organisation malaria no longer poses a problem. Therefore it is not proposed to go into its prevention and treatment except to state that if malaria is diagnosed at any period in pregnancy, curative treatment using any of the anti-malarial drugs—Atebrin, Plasmaquin, Paludrine, Camaquin etc. should be carried out. Pregnancy is no contra-indication for the use of these drugs. Quinine also can be employed though it has a reputation as an abortifacient which is not borne out by facts. Abortion, premature labour and intra uterine death of the foetus are more likely to occur because of the high swinging temperature in malaria rather than because of the drugs administered for its cure.

Filariasis

This disease may sometimes affect the pregnant woman. The common manifestation is an ELEPHANTOID GROWTH of the vulva, which may be extensive enough to produce mechanical obstruction to the passage of the fœtus during labour. Another effect of filariasis is CHYLURIA in pregnancy. The occurrence of filarial fever itself may occasionally interfere with pregnancy.

It is not advisable to remove the growth during pregnancy. The ideal time for surgical removal would be two to three months after delivery. If the growth is large, cæsarean section should be preferred to vaginal delivery for in the latter event extensive tears are likely to occur. These laceration cannot be sutured and often slough resulting in severe infection. At times in the absence of medical assistance elephantoid growth of the vulva may give rise to obstructed labour resulting in rupture of the uterus.

Chyluria is at times a troublesome complication. The treatment of this condition leaves much to be desired. Administration of Hetrazan 3 mgm. per Kg. of body weight orally three times a day may help in the acute stage of the disease.

Thyrotoxicosis

This grave affection, though rare, occasionally complicates pregnancy. The onset may be sudden or insidious. It may occur during pregnancy or may ante-date conception. In some cases there is a marked increase in the severity of the symptoms of thyrotoxicosis with the onset of pregnancy. Occasionally, however, thyrotoxicosis may diminish late in the course of pregnancy with an exacerbation during labour and gradual subsidence during the puerperium.

The usual signs and symptoms of the condition may be noted. Palpitation and tachycardia are troublesome symptoms. The majority of these cases are mild in nature and can be controlled by medicinal methods of treatment. The diet should be nutritious and generous so as to give enough calorific value to meet the increased metabolism. The chief drug which is relied upon is iodine. This is given generally in the form of Lugol's iodine, and the dose is gradually increased—2 to 10 minims being given three or four times a day. After a fortnight, iodine therapy may be temporarily stopped and started again if symptoms manifest themselves. For the mental irritability bromides and luminal may be prescribed. The modern drug therapy of hyperthyroidism consists in the oral administration of 300 mgm. daily of methyl thiouracil reducing it to a maintenance dose of 150 mgm.

daily. The drug at times gives rise to side reactions and overdosage may result in hypertrophy of the foetal thyroid, which however subsides within a few weeks of birth.

Preoperative iodine therapy followed by subtotal thyroidectomy in those not responding to treatment has been advocated. Radio-active iodine should never be used in pregnant women because of its concentration by the foetal thyroid after the thirteenth week. There is no indication for termination of pregnancy.

Epilepsy

Among neurological disorders epilepsy is a common one. When an epileptic becomes pregnant, the convulsions will have to be differentiated from eclampsia. This is not difficult as in epilepsy there is often available a history of convulsions prior to pregnancy and in eclampsia there are the associated signs and symptoms—hypertension, œdema and albuminuria.

Generally, epilepsy is not affected by pregnancy. In some instances it is ameliorated by gestation whereas in others the frequency of convulsions is increased.

The treatment is the same as in the non-pregnant. Therapeutic abortion is rarely indicated. However, because of the hereditary elements in the disease and the mental deterioration seen in many epileptics, with advancement of the disease, sterilisation after two or three deliveries should be considered.

Osteomalacia

This is a chronic disease occurring usually in women, characterised by decalcification and weakness of the bones, ultimately resulting in various forms of deformity and sometimes fracture.

Although osteomalacia is rare in most parts of the world, it would appear to be frequent in certain endemic areas.

It usually occurs between twenty and thirty years, although cases have been noted at a much earlier age. It is a deficiency disease due to lack of certain vitamins (A and D) and occurring more commonly under poor hygienic surroundings with lack of sunlight. It is not confined to the poor, although it is naturally more frequent among the poorer classes.

Symptoms. The onset may be insidious, so that the disease may not be recognised till it has reached an advanced stage. Pain, particularly referable to the bones in the pelvic region and the back, and sometimes to the extremities, may be a prominent symptom. Tenderness over the affected bones may be present. Deformity of the spine or lower extremities may be observed and fracture of the bones from very trivial causes may be noted. In a woman who is pregnant, any symptoms referable to the bones should always arouse the suspicion of osteomalacia in an endemic area. Pelvic deformity occurs early. There may be general weakness, associated with atrophy of the muscles. Symptoms of anæmia occur early, and tetany and fibrillary twitchings of the muscles may occur.

When the disease has persisted for sometime, the patient is unable to walk, the pelvic and the long bones are very much deformed ; severe pain may be present in the acute forms of the disease. When the disease has become chronic the pains are not severe, and by this time deformities of the spinal column such as lordosis or kyphosis may be present and the patient may assume a waddling gait. Soon, however, the patient is unable to move about and becomes hopelessly crippled. The commonest form of deformity of the pelvis resulting from osteomalacia is the *Triradiate pelvis*. This is particularly to be noted in view of the complications that it causes at the time of labour.

The extent of the deformity resulting from osteomalacia depends entirely upon the degree of softening of the pelvic bones. When the bones have become very soft, the pressure exerted upon the bones by the femora on either side and by the weight of the trunk compresses it to such an extent that the promontory is pushed downwards and forwards, while the femora push the lateral walls of the pelvis inward. It is from this cause that the superior strait of the pelvis presents a triradiate appearance. The pubic arch becomes very narrow, the rami being pushed markedly forward, giving rise to the characteristic beak-like protuberance on the anterior wall of the pelvis. The size of the pelvic cavity is very much diminished.

Diagnosis. It may be diagnosed from the characteristic clinical history of the disease ; its occurrence in the endemic area, the peculiar muscular palsies, the pains in the joints, the softening of the bones and various deformities. With each successive pregnancy the symptoms may become intensified. After delivery the pains generally disappear and when the patient begins to move about she realises the nature of the deformities.

Treatment. *Prophylactic.* In endemic areas, it is preferable to give pregnant women an abundant supply of vitamins, particularly vitamins A and D, in the shape of cod liver oil. Exposure to sunlight

is essential. Suitable diet, which will include plenty of fresh milk and a sufficiency of proteins, must be provided.

Curative. When the disease is seen in its early stages, energetic treatment ought to be adopted. Sunlight, plenty of cod liver oil and attention to the general hygienic is of importance. Vitamin D must be given in large doses. 25-100 thousand units along with calcium and phosphorous supplements. The diet should be liberal and comprise foods rich in calcium salts and phosphorus, such as milk, eggs, fish, sweet-bread and meat. Where softening of bones is noted, it is desirable to keep the patient at absolute rest in bed for a long period to avoid deformities.

Management of labour. If proper treatment be adopted in the antenatal period, the difficulties may be considerably diminished when the patient goes into labour. If, however, the pelvis is badly deformed, cæsarean section is the treatment of choice.

When a definitely osteomalacic deformed woman again becomes pregnant the question of therapeutic abortion may have to be considered, since the continuance of the pregnancy may lead to a rapid aggravation of the disease.

Maternal and prenatal mortality. Owing to the hazards of labour the risks to both mother and fœtus are high. Maternal deaths are usually due to genital tract injuries including rupture of the uterus, sepsis and shock.

At birth and during early infancy many of the babies of osteomalacic mothers appear to be normal. But most of them within about six months develop rickets unless prophylactic measures have been adopted soon after birth. Lactation has a deleterious effect on the mother and so all babies born of osteomalacic mothers have to be artificially fed.

Leprosy

The scourge of leprosy is so widely prevalent in all tropical countries that cases occur where pregnancy is complicated by this condition. This is a disease produced by a specific bacterium and characterised by lesions of the skin, nerves and viscera, eventually resulting in anæsthetic patches, ulceration and a great variety of trophic lesions.

It is unnecessary to go into details with regard to the causation of this condition. Its importance with regard to pregnancy lies in the fact that when a leprotic woman becomes pregnant, there may occasionally be an exacerbation of the disease. The effect on the fœtus

has also to be taken note of. It is impossible in many cases to adopt adequate prophylactic measures, much as they are desirable, in tropical countries. The lack of proper organisation, the financial difficulties and the inadequacy of accommodation and proper facilities for the care of lepers make the problem so complicated and difficult that, at present, it may be said that in every large city and even in the rural areas there is promiscuous mixing of lepers with the healthy population. The pregnant woman should be isolated and carefully looked after. The pregnancy generally goes on to term and the fœtus is born in a healthy condition.

During the puerperium, there is a risk of puerperal sepsis. Particularly in the nodular and ulcerating types of leprosy, the genitalia should be protected from possible infection by contact with the soiled linen of the patient.

The child should be removed from the mother immediately after delivery and must be carefully looked after, preferably in an isolated room. If so treated, the child may escape leprotic infection. It is a moot question whether leprosy can be directly transmitted to the fœtus *in utero* ; but the possibility of the infection is very great because of the intimate association between the mother and the child, if the child is left to the care of the mother. The treatment of leprosy by Sulphones has improved the prognosis materially.

SURGICAL EMERGENCIES DURING PREGNANCY

THE question, how far operative measures in pregnant women affect pregnancy adversely, has been long discussed. The view commonly held is that it is not desirable that a pregnant woman should be operated on, because of the possibilities of interruption of pregnancy which adds risks to the mother and the child. As a general rule, it may be said that, if there is no urgency about the operation, it should be postponed till after the pregnancy terminates. On the other hand, improved techniques and safer methods of anæsthesia have made surgery in the pregnant woman less risky than before. There are, however, certain emergency operations which cannot possibly be delayed. The occurrence of any acute abdominal crisis, as in appendicitis, twisted ovarian cyst, acute intestinal obstruction, etc., necessitates immediate operation and should be undertaken irrespective of the period of pregnancy. The common complication following operation in pregnancy is abortion or premature labour. If the operation is performed between the 18th and 28th weeks these complications can be reduced to the minimum. Operations on the uterus itself are inadvisable in pregnancy. When an abdominal operation is indicated in the last weeks of pregnancy, the question should be considered whether it is necessary to deal with pregnancy at the same time.

Any acute abdominal condition which may occur in the non-pregnant can complicate pregnancy and these will have to be dealt with according to accepted general surgical principles. Only a few of these complications will be discussed.

Acute appendicitis. This is by no means an uncommon complication in pregnancy. An acute attack may start any time. With the growth of the uterus the appendix gets displaced upwards as the pregnancy advances. This anatomical displacement results in the pain and tenderness being located at a higher level than the usual point in the right iliac fossa. Difficulties in diagnosis therefore arise. Complications like suppuration, gangrene and perforation of the appendix are said to be more common during pregnancy. The consensus is that this is usually the result of delay in diagnosis resulting from anatomical displacements of the appendix. Clinically the symptoms are the same as in an attack in the non-pregnant—pain in right iliac fossa with nausea and vomiting. Tenderness and rigidity over the right iliac fossa are present. In pregnancy however after the

first trimester the pain, tenderness and rigidity (which may not be so marked) will be located at a higher level. As already stated elsewhere, acute pyelonephritis will have to be ruled out in diagnosis as also many other acute abdominal conditions.

The mortality in appendicitis is much higher in pregnancy due mainly to the delay in diagnosis, the higher position of the appendix making it an abdominal rather than a pelvic organ with corresponding difficulty in dealing with it. If the attack occurs in early trimester the risk of abortion is great 12-15%. When there is gangrene or perforation the abortion rate is nearly 80%.

Once a definite diagnosis is made it is best to operate as early as possible irrespective of the period of pregnancy. Intensive antibiotic therapy is inevitable in the treatment.

Intestinal obstruction. It is a rare complication in pregnancy. The symptoms and clinical features are the same as when it occurs apart from pregnancy namely pain, vomiting, constipation and abdominal distension. The presence of the enlarged uterus may confuse the abdominal signs and pain mistaken for labour pains. Treatment is surgical. If pregnancy is advanced it may be necessary to empty the uterus by cæsarean section to facilitate the treatment for obstruction. Mortality is high—20-55%.

Pregnancy Ileus. In this there is no organic cause for obstruction. It seems to be due to the same causes as are responsible for the lack of tone of the ureter and other smooth muscles in pregnancy. The large intestine is usually affected and may be enormously distended.

In this condition laparotomy is not indicated. Gastric suction, enema and continuous intravenous drip of 5% glucose saline will help in the management. Prostigmine 0.5-1 mgm. hypodermically will help in obtaining bowel movement. It should be differentiated from obstruction due to organic causes.

Other conditions requiring surgery in pregnancy are :

1. Ectopic gestation.
2. Torsion of an ovarian cyst.
3. Torsion of the gravid uterus or torsion of a subperitoneal fibroid.
4. A degenerating infected myoma which is generally rare.

These when diagnosed should be dealt with surgically. They are discussed in the appropriate chapters.

DISEASES AND ABNORMALITIES OF THE
FŒTAL MEMBRANES AND PLACENTA

DISEASES of the chorion, and amnion and anomalies and diseases of the placenta and umbilical cord are discussed under this heading.

Diseases of the Chorion

Hydatidiform Mole. Hydatidiform mole, otherwise known as vesicular mole, is due to the cystic degeneration of the chorionic villi resulting in the death of the fœtus and the conversion of the chorionic villi into a large number of vesicles varying in size from a small pea to a big-sized grape. They resemble hydatid cysts, and hence the name hydatidiform mole or vesicular mole. Hydatidiform mole is best regarded as a benign neoplasm of the chorion with malignant potential.

Frequency. Its incidence varies from country to country, being more common in Asia than in the West. During a five-year period, at the Madras Government Hospital for Women and Children, among 70,450 deliveries, including abortions, there were 201 cases of vesicular mole—an incidence of 1 in 352. It is more frequent in multigravidæ than in the primigravidæ and generally occurs in the early period of pregnancy, between the eighth and twelfth weeks, rarely after the sixteenth week. In the majority of cases, the fœtus dies and no remnant of it can be found later; but a few cases are on record where a dead fœtus has been found in association with hydatidiform mole.

Pathology. A normal chorionic villus consists of a central core of myxoid connective tissue carrying fœtal blood vessels surrounded by the trophoblast which consists of an inner Langan's layer and outer syncytial layer. The Langan's layer consists of small cubical cells with large vesicular nuclei and clear cytoplasm. The syncytial layer consists of large cells with deeply staining cytoplasm and numerous uniformly deeply staining nuclei irregularly distributed. After the fourth month the Langan's layer slowly atrophies while the connective tissue core becomes more fibrous and more vascular. Apart from malignancy, masses of trophoblastic cells may be carried as harmless emboli into the pulmonary capillaries of the mother where they soon die and are absorbed. Such emboli have been noted in normal pregnancies. They have also been seen in blood vessels and

lymphatics and are also seen invading the endometrium and myometrium in the early months. These characteristics of the trophoblast even when normal should be borne in mind.

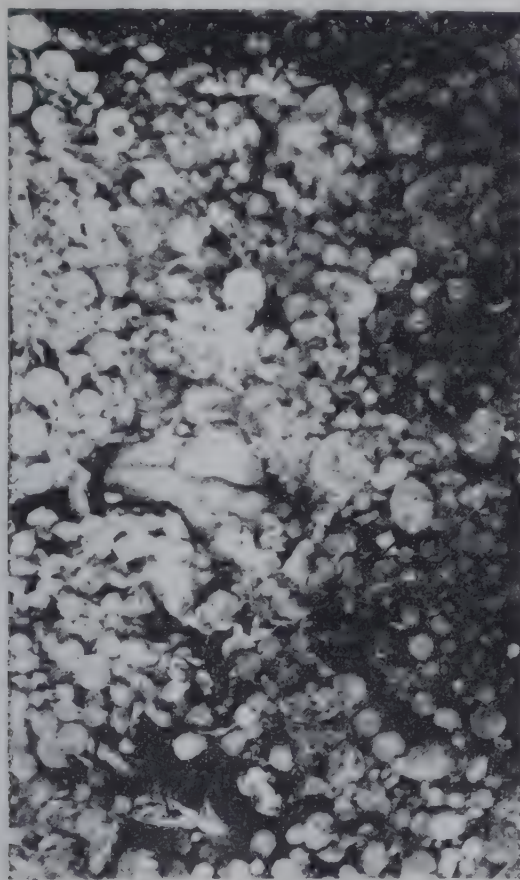


FIG. 57.—Vesicular mole.

When the chorionic villi undergo hydatidiform degeneration, there occurs first a swelling of the connective tissue core as a result of advanced myxomatous degeneration, with great increase in its fluid content (œdema) and resultant increase in size of the villus. This is accompanied by diminished vascularity and ultimately complete obliteration of the blood vessels. The epithelium of the grossly œdematous and cystic villi becomes thinned and atrophic, and in many, only sparse syncytium may be seen which disappears when necrosis occurs. In some of the smaller vesicles the covering epithelium may show signs of very active proliferation with increased cellularity. Solid masses of Langan's cells and syncytia may even be seen infiltrating the decidua and underlying myometrium. In some cases, such masses of trophoblastic cells are seen as vaginal nodules pointing to a suspicion of malignancy. These trophoblastic masses reach the vagina by venous embolism and its common site is the anterior vaginal wall below the urethra where it is seen as a dark bluish mass. Because of the physiological invasiveness of the trophoblast, the diagnosis of malignancy on this evidence alone may prove to be incorrect.

Histopathologic Appearance and Malignancy. One of the dangerous complications of a hydatidiform mole is the development of subsequent malignancy. Various authors have made attempts to forecast the malignancy by histological examination of the expelled mole and material obtained on curettage at the time of evacuation. There are wide variations in these reports. It is imperative that all expelled moles should be histologically examined. Ordinarily, these moles could be grouped under three heads for assessing prognosis.

1. Moles which show no evidence of anaplasia of the covering trophoblast and only a slight to moderate evidence of hyperplasia. The syncytial cells and cytotrophoblasts can be easily distinguished. Such moles seldom give rise to complication after evacuation and are usually benign.

2. Moles which show a slight to moderate anaplasia of trophoblastic cells are often associated with very marked hyperplasia. The syncytial masses and their nuclei are larger and clumping of chromatin is present within the nuclei. The orderly arrangement of the syncytial and cytotrophoblasts about the villus core is lacking. These types are capable of giving rise to trouble and occasionally result in what may be called invasive mole. The trophoblastic tissue penetrates deeply into the uterine musculature and may even perforate the uterus. Vaginal and pulmonary metastases also may occur. They should be considered as potentially malignant.

3. Moles which show marked anaplasia of the trophoblast. These anaplastic undifferentiated cells resemble the very young type of trophoblastic cells. The cellular outlines are generally indistinct, nuclei large hyperchromatic with irregular coarse chromatin granules. In this type of mole, the incidence of malignancy is greater. It may, in some cases, give rise to either an invasive type of mole or a choriocarcinoma. They at times metastasize in the lung, vagina, brain and skin. In spite of the pathological correlations and malignancy, it is extremely difficult to give a correct prognosis, without a follow-up for one to two years in such cases.

The Ovaries in the Hydatidiform Mole. In a large number, the ovaries are found to be the seat of cystic growths. These cystic growths are less commonly seen in chorion epithelioma. Histologically the cysts are lutein cysts. In some cases, these lutein cysts grow only after the expulsion of the mole. These lutein cysts arise from a strong and prolonged stimulation by the excessive amounts of chorionic gonadotrophic hormone produced by the trophoblast. They are usually only of moderate size—three to four inches in diameter and within the pelvis so that they can be made out on vaginal examination. They are often bilateral. Occasionally, they may grow to a large

size and become palpable *per abdomen* and may undergo torsion after the expulsion of the mole. Within a few weeks of expulsion these cysts involute and disappear but at times they may persist even in the

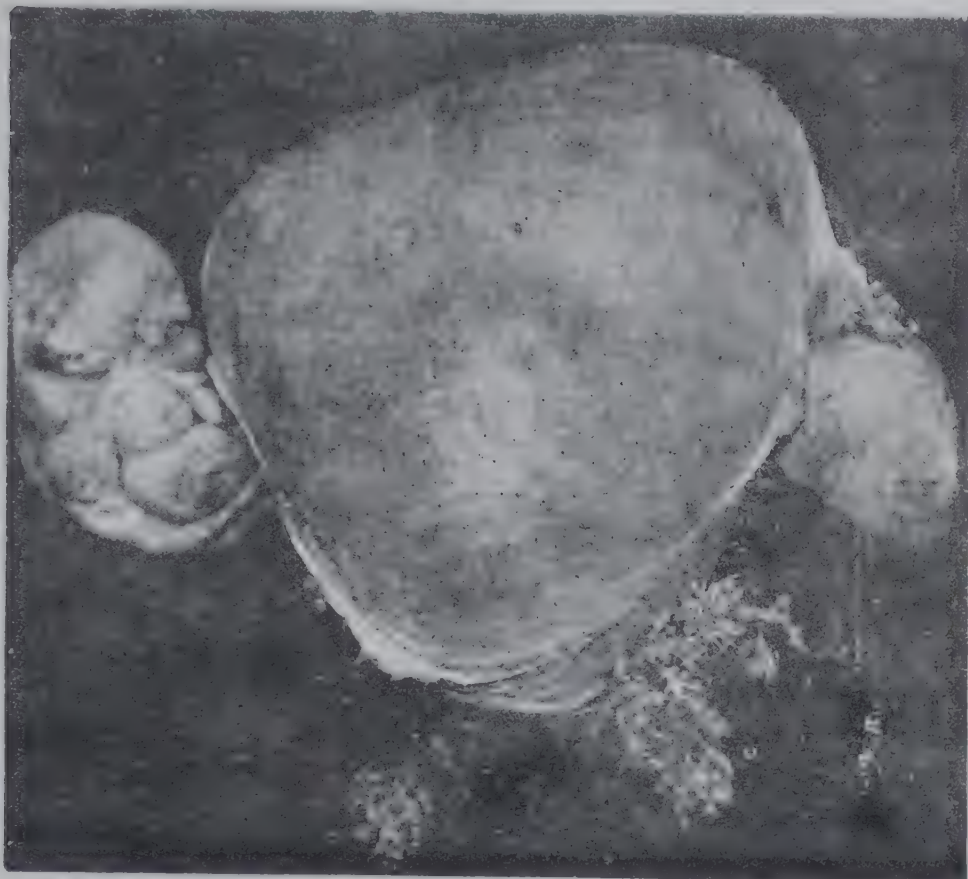


FIG. 58.—Uterus with a vesicular mole showing also lutein cysts of the ovaries.

absence of malignancy for a longer period of three to six months. The fluid within the cyst gives a positive biological test for pregnancy. It is doubtful whether the persistence of the lutein cysts is directly related to the malignancy seen in cases of molar pregnancy.

Hormonal Changes in Molar Pregnancy. Zondek stated that high levels of chorionic gonadotrophin were diagnostic of vesicular mole. Ordinarily, when the excretion of gonadotrophin reaches 400-600 international units per litre of urine, a positive pregnancy test is obtained. During normal pregnancy, there is a sudden sharp rise about the sixth week of pregnancy in the excretion of this hormone. It reaches a maximum rapidly and declines by the 12th week. This physiological rise ranges from 75,000 to more than 1 million units. It is obvious therefore that Zondek's old dictum—'the diagnosis of vesicular mole or chorion epithelioma should be suspected with excretions of more than 50,000 units and considered established at levels of 200,000 units or more'—is untenable. When the peak has passed, the level is maintained at 1500-5000 units and remains

at these levels until delivery. Therefore, in the diagnosis of a mole, it is the changes in the levels of excretion rather than the absolute value which help in the diagnosis. The physiological peak seldom persists for more than six weeks and comes down after the 12th week. If high levels are persistent for over six weeks and after the 12th week, it is very characteristic of molar pregnancy. The spinal fluid, unlike in normal pregnancy, gives a positive pregnancy test. Ordinarily, the test is positive in high dilutions—1 in 250 and over. It is uncommon to find the test positive in dilutions of 1 in 500 or over in any other condition. Rarely is the test negative, except when the mole is 'blasted' and has ceased to grow. Once the mole has been completely evacuated, the hormone level begins to drop rapidly. In a large majority, in the absence of complications, the pregnancy test becomes negative within a week to three months. In the absence of malignancy or another pregnancy, it is rare to find it persisting over three months. These findings are made use of in planning the follow-up of patients after a molar pregnancy.

Symptoms. 1. *Bleeding.* The most outstanding symptom is the abnormal uterine bleeding following a period of amenorrhœa. The bleeding is intermittent or continuous. There may only be spotting at times and it may last for weeks. In between, there is a persistent serosanguinous discharge. Along with the bleeding, sometimes bits of tissue containing vesicles are passed *per vaginam* and an inspection of the material so passed—which should never be omitted—helps in clinching the diagnosis. Severe hæmorrhage, sufficient to produce shock and collapse, is quite common in these cases and constitute a grave danger.

2. *Size of the Uterus.* In most cases, the size of the uterus is bigger than the corresponding period of amenorrhœa. It is mostly due to the enlarged ovular mass and at times due to concealed hæmorrhage inside the uterus when the invading trophoblast opens up the maternal blood sinuses. In 70% of our cases of molar pregnancies, the size of the uterus was bigger than the period of amenorrhœa while in 15% it corresponded to it. A uterus of normal size or sometimes even smaller than the period of amenorrhœa does not preclude the possibility of a molar pregnancy.

3. *Symptoms of Toxæmia.* Excessive vomiting in the early months of pregnancy and signs of pre-eclamptic toxæmia prior to the twentieth week of pregnancy should raise suspicion of a molar pregnancy. Hypertension, albuminuria, œdema, vomiting and even eclampsia have been observed in hydatidiform moles.

Diagnosis. Diagnosis is not always easy. An enlarged uterus bigger than the period of amenorrhœa, with no palpable fœtus or

audible fœtal heart, though a characteristic of vesicular mole, may be met with in early twin pregnancy with hydramnios when it will be extremely difficult to palpate the fœtal parts. The pregnancy diagnosis test may be positive in dilutions in both but titres positive over 1 in 500 will be most suggestive of molar pregnancy. A very carefully taken radiograph may reveal the fœtus if pregnancy is beyond 18 weeks. From a normal single pregnancy it is less difficult to differentiate a vesicular mole. The characteristic boggy feel in a uterus pregnant with a mole is often very suggestive. Vaginal examination may reveal absence of ballottement and the presence of lutein cysts in the ovary. Occasionally, a metastatic nodule—bluish in colour—may be seen in the vagina in molar pregnancy. When a fœtus is visualised radiologically, it rules out a molar pregnancy, except in rare instances wherein a part of the placenta only has undergone hydatidiform change.

We have, for some years, in select cases, where plain X-ray has not revealed a fœtus, resorted to X-ray after injecting 20 ml. of radio-opaque substance (Neo-Hydriol) into the uterine cavity *per abdomen* using the same technique as for amniography when the uterus is near the umbilicus or above. Pictures taken immediately after show the vesicles clearly. This is not recommended as a routine. Its disadvantages are the same as for amniography—namely abortion and infection. In 35 cases so investigated, in only one instance was the diagnosis wrong. Twice the mole was expelled spontaneously within twenty-four hours and in no case was there any infection. We do not think this procedure necessary to diagnose a mole, but in certain cases where the findings are uncertain and where the continuation of a normal pregnancy has been ruled out, this procedure is helpful and harmless.

It is always necessary to examine anything passed *per vaginum*, as in a number of cases vesicles can be seen in the blood-stained discharge on inspection. The presence of such vesicles, of course, confirms the diagnosis. The value of hormonal assay in the diagnosis has been discussed previously.

Treatment. Once a molar pregnancy is diagnosed, it is essential to empty the uterus as soon as possible. To determine the mode of emptying, various factors have to be taken into consideration: (1) the age and parity of the patient, (2) the condition of the os, (3) the size of the uterus and (4) the general condition of the patient.

(1) It is difficult to assess the importance of age and parity in planning the treatment. In general, it may be stated that, in women over 40 years, the chances of malignancy developing are very great (nearly 40%). Hence a total hysterectomy would seem to be the best line of treatment. Our experience has been that parity is more impor-

tant than the age factor. We see a fair number of varying grades of malignancy, including chorion epithelioma, in women between 25 and 35 years and even in younger persons who have had a number of children—usually four or more. It seems probable that frequent pregnancies preceding a molar pregnancy may influence the development of malignancy, irrespective of the age. All the same hysterectomy in the younger age groups is not recommended as a routine. Apart from this group, the mode of evacuation is either vaginal or abdominal.

Before such methods are adopted it is necessary to check the hæmoglobin level of these patients, as even in those who have not collapsed after severe hæmorrhage, frequent small bouts of bleeding would have rendered them anæmic. These patients must have blood transfusion. When patients are seen with bleeding and partial expulsion of the mole, the best treatment would be to evacuate the uterus under anæsthesia while at the same time a blood transfusion is given to combat the loss of blood. Prior to evacuation methergine 0.25 mgm. is given intravenously to help the uterus contract and control the bleeding. If the os does not admit a finger, it must be carefully dilated with metal dilators, with all aseptic precautions and the mole evacuated. If the size of the uterus is large, an ovum forceps may be introduced into the uterine cavity, the mole is gently stirred up and partly expressed and the loose ones partly removed by the ovum forceps. Once the size of the uterus becomes small enough for the finger to explore it thoroughly, the exploration should be done and the uterus emptied. There is often profuse bleeding during evacuation and sufficient blood must be available for replacement. The question of curettage will be discussed later.

(2) Sometimes patients are seen in whom the diagnosis of vesicular mole has been made, but the os is tightly closed and there is no bleeding. The uterus may be enlarged suggesting 16 weeks or more of pregnancy. In such cases, especially in multipara, the cervix may be dilated and two to three laminaria tents introduced into the cervical canal. Twenty-four hours later the tents may be removed and the cervix further dilated and the uterus evacuated. This procedure can also be adopted in primigravida in whom the cervix is more likely to be non-yielding.

(3) If the size of the pregnant uterus is over 28 weeks pregnancy, abdominal hysterotomy is recommended in the primigravida, a lower segment hysterotomy being preferred. The lutein cysts of the ovary must not be removed. The advantage of abdominal hysterotomy is that it is a clean operation and the evacuation is thorough with minimal loss of blood. Abdominal hysterotomy is also indicated in patients bleeding profusely through a closed os. Spontaneous expulsion of the mole is not at all uncommon. When therefore there is no urgency,

with a patient in a satisfactory condition, an attempt may be made to help spontaneous expulsion by the use of intravenous oxytocin drip—20 units in 500 cc. of 5% glucose saline given at a rate to promote effective uterine contractions.

In cases where the cervix is not easily dilatable, instead of resorting to abdominal hysterotomy, evacuation by vaginal hysterotomy may be done with very satisfactory results. In fact, even in primigravida with a uterus over 30 weeks size the uterus may in suitable cases be emptied by vaginal hysterotomy. These patients seldom have any trouble in a subsequent pregnancy.

In every case, it is imperative to have sufficient blood for transfusion as hæmorrhage and shock are common in these cases.

Curettage. Controversy exists over the question whether, after the evacuation of a mole, spontaneous or otherwise, the uterus should be curetted or not. There are certain distinct advantages in curetting: (1) the obstetrician is certain that the evacuation is complete, (2) material is obtained for histopathologic examination to assess the prognosis; for this more than the evacuated mole, the scrapings from the decidua are more useful, and (3) if the patient returns at a later date with vaginal bleeding and enlarged uterus, one can be certain that it is not due to remnants left behind. As against these, the danger is perforation of the uterus. There is no doubt that the uterus can easily be perforated by curettage, if it is carelessly done. After intravenous injection of Methergine, the uterus usually contracts and careful gentle curetting will not perforate the uterus. Considering everything, we are in favour of carefully curetting the uterus at the time of evacuation. Should, however, it be considered dangerous at the time, curetting can be done with safety a week later before the patient goes home. There is also the possibility that if remnants of mole are left behind, the biological test may take longer to become negative, while there is no actual proof that malignancy is more common in cases with incomplete evacuation. At times, incomplete evacuation has at a later date led to an unnecessary hysterectomy on the supposition of malignancy when the patient came back later with bleeding.

The complications of vesicular mole are hæmorrhage and shock, infection, and later the development of malignancy. It is very necessary that these patients be followed up for a period of at least 1-2 years from the time of evacuation of the mole.

The Follow-up. This is usually done by the pregnancy test. A week after the evacuation, the test should be done. If it is negative, seldom does malignancy occur. These patients should be asked to

report for a check-up three months later when, if pregnancy test is negative, they need be seen, in the absence of any bleeding, six months later only and then after one year. If the test becomes positive after being negative, the possibility of pregnancy should be borne in mind. It is advisable from the follow-up point of view, that these patients avoid pregnancy for a year.

When the test is positive at the time of discharge, it is best to have it done in dilutions so that a watch can be kept on the fluctuating hormone level. A fortnight later the patient should be seen again, when if the test is negative she should be seen three months, six months and one year from the time of evacuation. When on these occasions the test is negative, there is little chance of any further complication occurring.

If the test is positive at the second visit, i.e., a fortnight after discharge, it should be done in dilution. If the quantitative test shows diminishing hormone level, she should be followed up by such tests every fortnight till it becomes negative and after that once in three months and six months for a period of two years.

When the pregnancy test continues to be positive without showing a drop in hormone level, even at the end of three months, or it continues to be positive at higher dilutions showing increased hormonal production, the commencement of malignancy should be strongly suspected and further investigations should be done. All patients should be asked to report whenever there is irregular or profuse vaginal bleeding. To reduce the incidence of malignancy prophylactic chemotherapy after the expulsion of a mole has been recommended. The chemotherapeutic agent employed commonly is a folic acid antagonist—amethopterin—(Methotrexate). The drug can be administered orally or parenterally—The drug gives rise to toxic reactions which are discussed under 'Chorion epithelioma and chorioadenoma destruens'.

In the younger group of patients after evacuation of a mole it would seem to be useful to administer Methotrexate in doses of 10-15 mgs. orally daily. The dosage and duration of treatment depends upon the reaction. Ordinarily 75-100 mgs. constitute one course. In the absence of any toxic reaction a second course is given after an interval of seven days. Not more than three such courses are administered. The aim is to push the drug to the limits of tolerance. Reports from Manila where the incidence of trophoblastic growths is perhaps the highest in the world suggest that the incidence of malignancy could be reduced by prophylactic chemotherapy after the expulsion of a mole.

Chorion Epithelioma and chorio-adenoma destruens

For nearly a century now the existence of occasional malignant characters in chorionic epithelium has been recognised and various grades of malignancy with varying incidence have been reported. These have followed, in the majority of cases, a molar pregnancy, abortion and normal full-time labour in the order of frequency. Among the types of malignancies discussed, the majority are chorio-adenoma destruens (invasive mole) and chorion epithelioma.

Chorio-adenoma destruens is locally malignant and many deaths from internal hæmorrhage, due to perforation of the uterus by the growth, have occurred. Metastatic deposits in the lower genital tract and lungs also occur at times in this condition. In our clinic in a series of 125 cases of vesicular moles during a four-year period, chorio-adenoma destruens developed in 6%. There were 27 cases of chorion epithelioma among 79,896 deliveries giving an incidence of 1 in 2958.

Chorion epithelioma occurs more commonly after hydatidiform mole than after any other form of pregnancy. In 27 cases of chorion epithelioma, 11 were preceded by vesicular mole (40%), 11 by abortions (40%) and 5 were after full term delivery (20%). The interval between pregnancy and onset of symptoms ranged from 3 weeks to 3 months in over two-thirds of the cases.

Pathology. To the naked eye the tumour appears as a dark hæmorrhagic necrotic mass, usually found attached to the fundus of the uterus which is often enlarged. These tumours may also be found invading the myometrium and in chorio-adenoma destruens and in chorion epithelioma they can be seen as dark purplish nodules on the surface of the uterus. Perforation of the serous coat by these tumours gives rise to profuse hæmorrhage. These tumours may invade the broad ligament, and metastases in the vagina, lungs, brain and skin occur by blood stream spread. We have had instances where the first symptom was due to brain metastases in the form of convulsions.

Histologically the highly malignant tumour is completely lacking in stroma and blood vessels and consists of masses of multinucleated syncytial cells, small well-defined polyhedral cells corresponding to Langan's layer and intermediate cells of variable size and shape having highly invasive properties. The diagnosis of choriocarcinoma is to be based on the atypical hyperplasia and anaplasia of the trophoblast, the presence of hæmorrhage and necrosis, extensive invasion of the surrounding tissues and the absence of well formed villi. In chorio-adenoma destruens it is often possible to demonstrate villi in the section.

Symptoms and Signs. Intermittent vaginal bleeding, post-partum or post-abortal, which may manifest itself any time upto three

or four years, is the first symptom. This is often accompanied by a progressive wasting anæmia and later an offensive vaginal discharge and low grade fever. At times, hæmoptysis resulting from secondaries in the lung may be the first symptom. Occasionally, the patient may notice a vaginal metastasis below the urethra. Examination reveals an enlarged uterus. Sometimes a polypoidal mass could be felt through the os bleeding profusely on touch. In one of our cases it was associated with an inversion of the uterus. However, not all tumours are intra-uterine. Some are completely intramural and can be missed even on curettage. The common sites of secondary deposits are the lungs, vagina, vulva and the brain. When deposits occur in the lungs, hæmoptysis, pleural pain and fever are predominant symptoms. Coma and convulsions may result from cerebral metastases while alarming hæmorrhage may result from the vaginal nodules.

The test for pregnancy is in the large majority positive even in dilutions. Occasional low titres and even negative results are seen when the tumour is intramural and encapsulated.

Diagnosis. When a patient is seen with irregular vaginal bleeding following the expulsion of a mole, abortion or labour, the possibility of chorionic malignancy should be borne in mind, especially if the uterus is also enlarged. The alternative to chorionic malignancy is the retention of products of conception, incompletely evacuated mole, and placental or submucous fibroid polypus. Biological test for pregnancy will help in diagnosis. A histological examination of curettings at this stage will help to clinch the diagnosis.

Prognosis. The prognosis in chorion epithelioma is grave. In our series of 27 cases, the mortality has been 51.8% in those followed up for 2-5 years. In chorio-adenoma destruens the prognosis is far better. If diagnosed early and treated by surgery, the results are good.

Whatever treatment is adopted, the surviving cases of chorion epithelioma must be followed up with pregnancy tests for at least three years. After successful treatment the test becomes negative in 95% within one to three months. If it is positive for longer than this period, the prognosis is grave.

Treatment. Prior to treatment it is necessary in these cases to take an X-ray of the lungs to rule out the presence of secondaries. Their presence makes the prognosis poor. Blood transfusion will be required in all cases and total hysterectomy with bilateral Salpingo-oophorectomy is the treatment of choice. In the younger age group many recommend conserving the ovaries, as it is stated that ovaries are seldom the seat of secondaries. We do not retain the ovaries as in 25 cases of chorion epithelioma, secondaries were found in the ovaries in 5. It is stated

that once the primary focus is removed, the secondaries will regress. In frank choriocarcinoma, it seldom does. Occasionally, vaginal metastases have regressed in chorio-adenoma destruens. Vaginal nodules however can easily be excised.

Chemotherapy

The advent of chemotherapy has revolutionised the treatment and prognosis in cases of trophoplastic growths of all grades of malignancy including chorio-carcinoma. The chemotherapeutic agent employed is an antifolic acid drug amethopterin (Methotrexate). Good results have been reported by many workers using Methotrexate in the treatment of metastasis. Hertz and his colleagues who have the largest experience with this form of therapy gives all such patients daily intramuscular injections of from 10 to 30 mgms. of Sodium Methotrexate in aqueous solution in courses of five days each. They continued the courses of treatment until there was no clinical, radiological or hormonal evidence of disease. The number of courses varied from one to eleven. Toxic reactions during treatment were common. It is necessary to stop the drug at the onset of reactions and wait for all toxic effects to pass off completely before the drug is continued. It is also useful to have a break of 7-10 days between each course. Hertz believes that it is not necessary to do hysterectomy when there are metastasis elsewhere. He believes primary chemotherapy alone gives better results and especially in the young woman who is anxious to have a child chemotherapy is preferable to hysterectomy.

Our experience in this field is very limited and it is confined to oral administration of Methotrexate. Starting with 5 mgms. daily the dosage is gradually increased to 25 mgms. a day till a total of 150-200 mgms. are given as the first course. During therapy reactions are watched for and when it occurs the drug is discontinued. The reactions commonly encountered are vomiting, diarrhœa, stomach pain, bleeding from gums and nose and bone marrow depression indicated by falling levels of hæmoglobin, white cell and platelet counts. During treatment Hb. level white cell and platelet counts are done bi-weekly and when reactions occur or when the white cell count drops to 2000 or less the drug is withdrawn to be restarted after the patient is free of all reactions for some time and the bone marrow depression overcome. At the end of each course assay of urinary gonadotrophin is carried out. Between each course an interval of 7-10 days is given in the absence of reactions and more if there had been any. The courses of treatment are repeated till all metastases have disappeared—clinically and radiologically—and the hormonal assay gives repeated negative results. The results of treatment have been encouraging.

There is now controversy regarding the place of primary hysterectomy in the treatment of this condition in view of the satisfactory results

with chemotherapy. In the older woman with sufficient number of children with lesions confined to the uterus—whatever be its degree of malignancy—we believe that primary hysterectomy has still a place. This may be followed by a course or two of chemotherapy if necessary. In the younger age group where preservation of child bearing function is indicated chemotherapy may be preferred to primary hysterectomy.

Where metastases are already evident in the lungs or elsewhere chemotherapy may be given a primary trial. Indication for surgery would be continuing vaginal bleeding and poor response to chemotherapy. Such cases have very poor prognosis.

When response to Methotrexate is poor, occasionally another chemotherapeutic agent may be used in conjunction. Vincal leukoblastin, 6-Mercaptopurine, Actinomycin D are some of the drugs so employed.

In a series of 111 patients with metastatic trophoblastic disease Hertz reported satisfactory and continued remission in 64% with this form of therapy.

The reactions to the cytotoxic drugs employed need to be emphasized. Liver and kidney disease are contraindications for the use of these drugs. Repeated blood transfusion would be necessary to combat bone marrow depression and anæmia. Folinic acid could also be used to allay toxic reactions.

Diseases of the Amnion

Hydramnios. In this condition there is an excessive quantity of liquor amnii present in the gravid uterus. The normal amount of liquor amnii present ranges from 1000 - 2000 ml. Anything in excess of this constitutes hydramnios. There may be considerable variations in the quantity of liquor amnii present in hydramnios and as much as 15 litres have been met with. The incidence is 0.5 to 1%.

Ætiology. The ætiology of hydramnios is still obscure. The excess of liquor amnii may be derived from several sources. It may be from the amniotic membrane itself or it may be from the fœtus, or the mother. Hydramnios is not infrequently associated with plural births or fœtal abnormalities. Anencephaly, spina bifida, and several other deformities of the fœtus such as talipes, ectopia vesicæ, congenital cystic kidneys, and œsophageal atresia, are found in 20-25% of cases. Hydramnios is found in 10-12 per cent of plural pregnancies and more often in uniovular than in binovular twins. It may affect only one sac. It is the rule in hydrops fœtalis due to Rh-immunization.

Diseased conditions of the mother involving secondary disturbances may lead to a diseased condition of the placenta with increased transu-

dition into the amniotic cavity. Thus in cardiac and renal affections, œdema of the placenta may occur and a greater amount of fluid may pass into the amniotic cavity.

Syphilis may be responsible in some cases, particularly when the viscera are affected. The maternal disease of major relevant importance is diabetes mellitus in which condition hydramnios is found in 30% of cases.

Symptoms. There are two types of hydramnios, chronic and acute. In chronic hydramnios the increase in fluid is gradual whereas in the acute variety it is sudden.

The symptoms of chronic hydramnios are largely those produced by mechanical factors as a result of the increased pressure exerted by the over-distended uterus upon the adjacent viscera and structures in the abdomen. Thus the pressure effects may be felt by the lungs, heart, kidneys, intestines, bladder, nerves and veins. The patient may complain of respiratory embarrassment due to pressure upon the diaphragm. Attacks of precordial pain, palpitation, cyanosis and dyspnœa may result from pressure upon the heart in association with pressure upon lungs. Pressure on the kidneys may result in diminution in quantity of urine passed; pressure on the stomach and intestines may result in indigestion and constipation; pressure on the veins may cause œdema of the



FIG. 59.—Hydramnios.

extremities; pressure on the nerves may give rise to pain in the lower extremities and neuralgia. Even with a fairly large quantity of liquor

amnii, the condition, if it is chronic, does not in many cases give rise to any severe symptoms of distress. On the other hand, in acute cases, the symptoms of distress are more in evidence, obviously due to the fact that the patient has not been able to adjust herself to the sudden and severe distension. Apart from the mechanical effects of pressure, acute hydramnios may give rise to a certain amount of shock and also cause severe pain from the sudden stretching of the uterine musculature and its peritoneal investment.

Hydramnios can occur at any time during pregnancy. Pre-eclamptic toxæmia is more common in hydramnios.

Acute hydramnios usually occurs about the fifth month of gestation, and may, in some cases, lead to premature termination of pregnancy. In uniovular twins such acute hydramnios occurs often in the early second trimester.

Diagnosis. The enlargement of the uterus, which is out of proportion to the period of pregnancy, the tense cystic condition of the uterus on palpation, together with a fluid thrill and occasionally the easy ballottement of the fœtus, will indicate diagnosis.

Hydramnios has to be differentiated from :—

- (a) Multiple pregnancy.
- (b) Ovarian cyst complicating pregnancy.
- (c) Ascites.
- (d) Concealed accidental hæmorrhage.

The differential diagnosis is easy, provided a careful examination is made.

In multiple pregnancy the uterus is never tense and numerous small parts of the fœtus are easily palpable, except in those cases where multiple pregnancy exists in association with hydramnios. Their differentiation without the aid of X-rays is often impossible, and it can only be surmised that, in addition to the hydramnios, multiple pregnancy may also be present. The fœtal heart is not easily audible in cases of hydramnios; but in uncomplicated cases of multiple pregnancy the fœtal heart is distinctly heard. Indeed two heart-beats can often be detected. The fœtal parts are easily felt and the uterus itself is lax.

Ovarian cysts may give rise to a great deal of abdominal enlargement if associated with pregnancy. A careful examination will reveal the presence of the fœtal parts and the cystic tumour separate from the uterus. An X-ray examination is of considerable value in some cases.

In cases of pregnancy complicated with ascites, characteristic shifting dullness may be demonstrated. A bimanual examination will reveal

that the uterus itself is not involved and that there is no undue tensity of the fluid within its cavity.

Concealed accidental hæmorrhage may sometimes be mistaken for acute hydramnios. In both cases there is a sudden acute distension of the uterus, associated with more or less severe pain and signs of shock. But in concealed accidental hæmorrhage, the secondary signs of hæmorrhage are manifest, whereas in cases of acute hydramnios no signs of hæmorrhage and collapse will be present.

Complications. Complications in a case of hydramnios may occur either during pregnancy or during labour.

Spontaneous onset of premature labour is common during pregnancy. Weak uterine contractions, premature rupture of membranes, presentation or prolapse of the cord, malpresentations and malpositions and abruptio placentæ may complicate labour.

Third Stage may be marked by retained placenta and post-partum hæmorrhage.

Prognosis. The prognosis is unfavourable both for the mother and the child. To the mother the risks incidental to excessive pressure, the complications in the three stages of labour and post-partum hæmorrhage add to the dangers.

The fœtal prognosis is poor. In at least 20% congenital abnormalities incompatible with life is present. There is a further increase in perinatal mortality from premature births and prolapse of the cord during labour. The total perinatal mortality may exceed 50%. In general the more severe the hydramnios the higher is the perinatal mortality.

Treatment. Minor grades of hydramnios may not require any treatment, and it is not infrequent that in such cases labour comes on prematurely and terminates spontaneously without undue risks to the mother or the fœtus. The general health of the patient must be attended to; she should be at rest in bed, and the bowels must be kept regular. Diuretics may help by promoting increased urinary output. On the other hand, in the severe forms of hydramnios, where the uterus is much distended and respiratory or cardiac distress is present, pregnancy may have to be terminated, irrespective of the period of gestation.

Where pregnancy is to be terminated on account of the distressing symptoms caused by excessive pressure, high rupture of the membranes

is the method to be employed. If the woman is in labour, it is desirable to rupture the membranes artificially, because, if the tense bag of membranes be allowed to rupture spontaneously it will result in the sudden escape of a large quantity of liquor. Such a large gush of water escaping suddenly may lead to prolapse of the cord or a fœtal limb or premature separation of the placenta.

For these reasons, when the patient is in labour and the cervix is beginning to dilate it is better to rupture the membranes artificially sufficiently high up, so as to allow the fluid to drain off under control and to see that only a limited amount of liquor amnii escapes. This is done by carefully passing a male metal catheter between the membranes and the uterine wall as high up as possible, but not so as to impinge upon the placenta. Then by sharply tapping the amniotic sac as much of the fluid is allowed to escape through the catheter as is necessary for the relief of tension. A Drew-Smythe's catheter is very useful for performing high rupture of the membranes.

A method that has come into vogue, and has been successfully adopted, is tapping the fluid through the abdominal wall. This has supplanted the old method of rupturing the membranes high up in patients who are not in labour. It has the advantage that gradual drainage and relief of tension are favoured. Labour sets in within a reasonable interval and generally terminates by natural powers without any complications. For tapping *per abdomen* all aseptic precautions should be taken, the bladder should be emptied and the paracentesis performed by using a spinal needle under local anæsthesia below the umbilicus.

Rupture of the membranes *per vaginam* brings on labour. When, however, the fœtus is premature it is advisable to postpone the onset of labour. Tapping the amniotic cavity *per abdomen* not infrequently permits pregnancy to continue. The hydramnios may recur but in such cases tapping may be done again. We have tapped such cases two or three times with no ill effects supervening. And so we prefer tapping *per abdomen* and relieving the patient when the fœtus is premature, as labour may not set in under such conditions.

In every case of hydramnios precautions must be taken to treat post-partum hæmorrhage, should it supervene. It is advisable to inject intravenously 0.25 mgm. of Methergine at the time of delivery of the head to prevent post-partum hæmorrhage.

Oligohydramnios. Oligohydramnios, otherwise known as oligamnios, is a condition associated with a decrease in the amount of

liquor amnii and is somewhat rare. The total amount of liquor amnii may be only a few ounces. Oligohydramnios sometimes occurs when the fœtus shows renal ægenesis, an imperforate urethra or other urinary tract abnormality. The result of this diminution in the quantity of liquor amnii is to permit adhesions developing between the membranes and the fœtus giving rise to various malformations. Some of these defects are due to the cramped space in which the fœtus has to develop ; others are due to amniotic adhesions encircling a part of the fœtus and thus compressing it.

The ætiology of this condition is not known. Clinically the uterus is smaller than normal and the fœtus relatively immobile.

When labour begins, the uterine contractions may be painful and weak and the first stage is thus protracted. The placenta may sometimes separate prematurely. Labour is not infrequently premature and may have to be terminated by artificial assistance. Owing to deficiency of liquor amnii, the fœtus may show signs of distress even before rupture of the membranes.

Anomalies and Diseases of the Placenta

Anomalies of the placenta may be of size, form, number, relationship and position.

Anomalies in Size. The normal weight of the placenta is about $\frac{1}{2}$ kg. and the ratio of the weight of placenta to the fœtus is as 1 : 6. In some cases, the placenta is very much smaller and this may arrest the development of the fœtus. In other cases the placenta may be hypertrophied, occasionally the weight being as much as 1 kg. Under such circumstances, there is a tendency for the fœtus to be much larger. A relative increase in the weight of the placenta may occur in certain diseased conditions such as syphilis, erythroblastosis and diabetes.

Placenta Membranacea. In this condition the placenta extends over the greater portion or even the whole of the chorionic surface, and the increase in area results in the formation of a thin and membranaceous placenta. As a result of this large placenta covering a greater surface area of the uterine cavity, the placenta tends to become *prævia*, which gives rise to ante-partum hæmorrhage. There is a tendency in the third stage of labour for the placenta to be retained or may be even adherent, and this causes post-partum hæmorrhage. This is fortunately

a rare form of abnormality, but when it does occur, manual removal of the placenta may be necessary.

Anomalies in Form. Among these may be mentioned :—

(1) *Lobate Placenta* (or multiple placentæ in single pregnancy). In this condition the placenta is divided into two or more lobes, and in some cases as many as seven lobes have been noted. Depending upon the number of lobes, the placenta is known as bipartite, tripartite, etc. There is a single cord attached to the placenta which divides into its constituent elements, and the vessels from each one of these lobes finally unite to form the umbilical vessels.

(2) *Placenta Fenestrata*. This condition is characterised by one or more solutions of continuity in the substance of the placenta through which the chorion is visible.

(3) *Horse-shoe Placenta*. Occasionally, the placenta is kidney-shaped, when it is known as a horse-shoe placenta.

In all these anomalies, difficulty may arise in the third stage of labour through partial detachment of the placenta and consequent post-partum hæmorrhage.

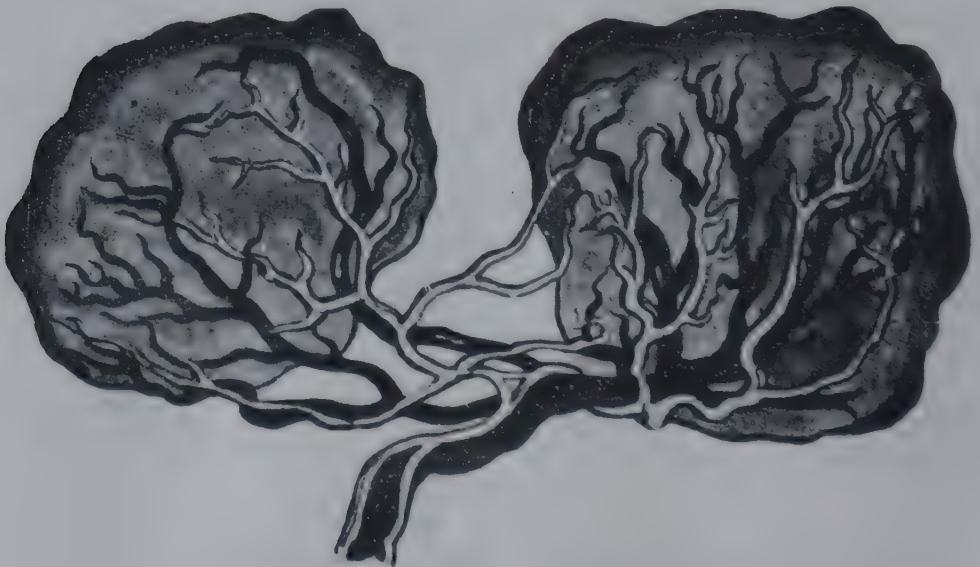


FIG. 60.—Lobate Placenta.

Anomalies in Numbers. Sometimes there are supernumerary or accessory placentæ. The commonest form of this anomaly is that known as *placenta succenturiata*. As many as half a dozen of these succenturiate lobes may be found within a single uterus.

In the third stage of labour, the succenturiate lobe may be retained within the uterus, causing post-partum hæmorrhage either primary

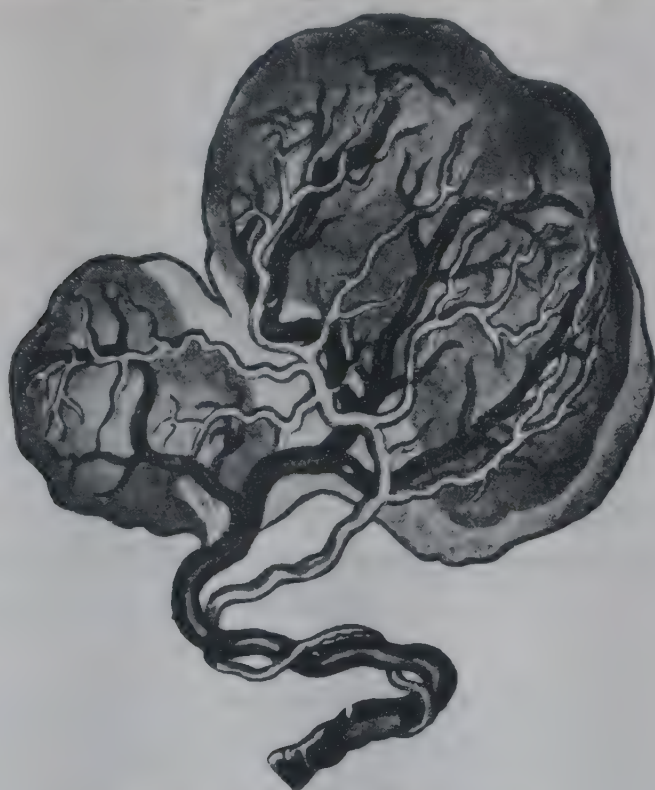


FIG. 61.—Placenta bipartite.

or secondary. Sapræmia may also result in the puerperium and later the succenturiate lobe may give rise to the formation of a placental polypus, causing severe and prolonged hæmorrhage. This condition should be looked for, and a careful examination of the placenta and the membranes after they have been expelled will always help in diagnosing it. Where a succenturiate lobe is retained within the uterus, an examination of the membranes will reveal a small round area of deficiency a short distance from the placental margin, and if it is also noted that torn vessels are present extending from the placenta to the margin of the tear in the membranes, the diagnosis becomes certain. When a missing succenturiate lobe is diagnosed after inspection of the placenta soon after delivery, it is always better to explore the uterus and remove the

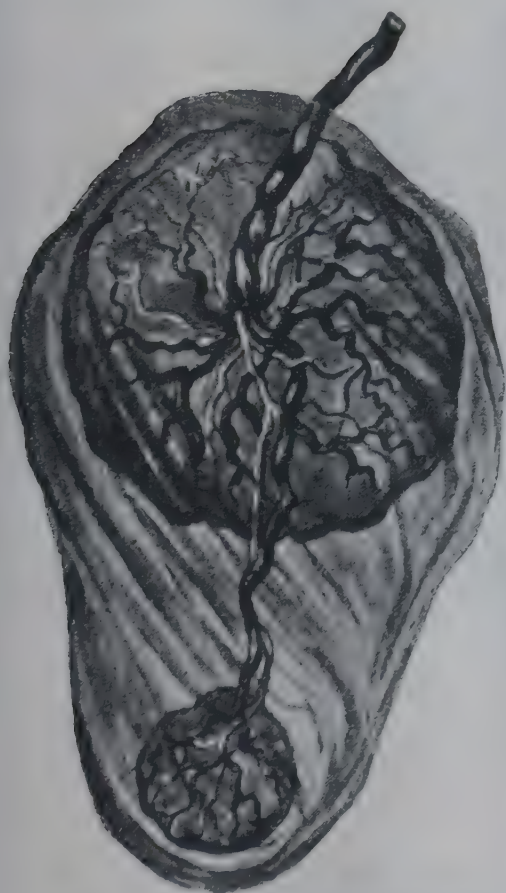


FIG. 62.—Placenta succenturiata.

lobe. Else secondary post-partum hæmorrhage, infection, subinvolution and later a placental polypus may result.

Anomalies of Relationship. In this condition there are anomalies of relationship between the placenta and the membranes or the cord. Among the varieties that may be met with are :—

(a) '*Battledore*' Placenta. This term is applied to a placenta in which the cord is attached to the margin of the placenta.

(b) *Placenta Marginata* or *Placenta Circumvallata*. Here the chorion is attached, not at the border of the placenta but within the placenta itself, a little distance from its margin, so that a portion of the placenta is present beyond the attachment of the membranes.

The clinical significance of these placental anomalies is twofold :—

(1) The amnion and chorion may be found intimately adherent, so that when the after-birth is expelled, portions of the membrane may be left behind.

(2) Incomplete detachment, retention of the placenta and atonic post-partum hæmorrhage are frequently encountered. With a circumvallate placenta ante-partum hæmorrhage is likely to occur when it has to be differentiated from placenta prævia. The baby is usually smaller and the height of the uterus is often less than that for the period of amenorrhœa. There may be intermittent bleeding but in

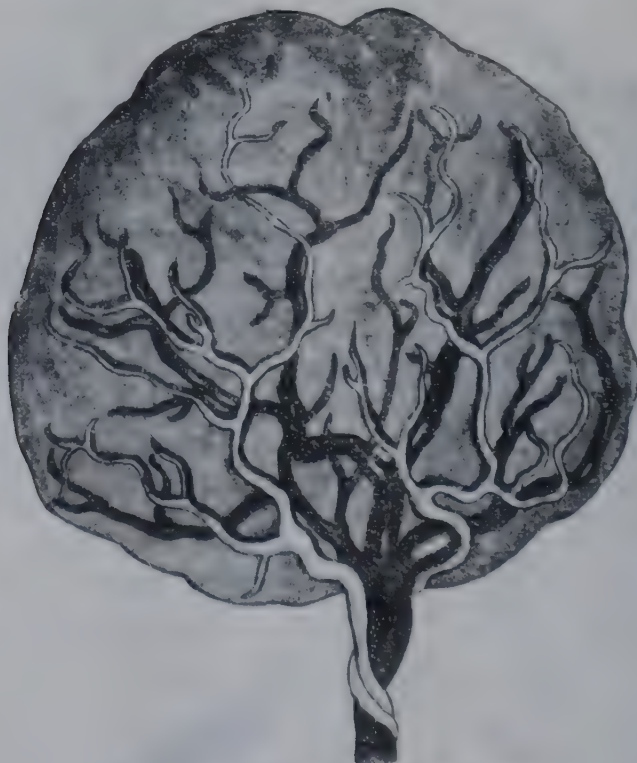


FIG. 63. '*Battledore*' Placenta.

between the bouts of bleeding there is often a persistent watery discharge. These findings are suggestive of circumvallate placenta.

Anomalies of Position. *Placenta Prævia.* The normal position of the placenta is in the upper uterine segment, on the anterior or posterior surface of the uterus, occasionally on the fundus itself. When the placenta is wholly or partially situated in the lower uterine segment, the condition is known as *Placenta Prævia*. This is dealt with in the chapter on ante-partum hæmorrhages.

Diseases of the Placenta

Pathological conditions in the placenta may affect the fœtus. Chief among these diseased conditions are :—

(1) **Infarct Formation.** This is the most frequent abnormality of the placenta and is generally found in conditions associated with increased arterial tension or venous congestion, for example, in chronic nephritis and the toxæmias of pregnancy. Cardiac disease and syphilis are also factors which may cause placental infarction.

There are no clinical symptoms characteristic of this condition. If it occurs in the first half of pregnancy, abortion is likely to result.

(2) **Placentitis.** Inflammation of the placenta may occur, although somewhat rarely. It may be either acute or chronic. The inflammation is generally not a primary condition, but may be due to extension of infection from the decidua due to an exacerbation of a pre-existing disease, for example, chronic gonorrhœa or any infective process of a pyogenic nature. In some specific infectious diseases also, inflammation of the placenta may occur. It has also been noticed in cases of intra-partum infection.

Two diseases which may affect the placenta are tuberculosis and syphilis. In tubercular infection of the placenta, caseating tubercles may be scattered chiefly in the decidua and rarely in the villi. This is extremely rare.

Syphilis is by no means infrequent and is a common cause of fœtal death. The syphilitic placenta is usually large, thick and lighter in colour than normal. Its weight is proportionately increased and may be one-third to one-fourth the weight of the fœtus. It is impossible to make any accurate diagnosis of syphilitic placentitis during pregnancy. Besides the risks to the fœtus, the maternal risks are due to retained or adherent placenta. With the modern methods of antisyphilitic treatment the prognosis is considerably better, if the condition is treated in time.

Among other degenerative changes in the placenta may be mentioned cystic degeneration, calcareous degeneration, fatty degeneration and occasionally hyaline degeneration. In calcareous degeneration,

the calcareous material is deposited on the maternal surface of the placenta, and occasionally it may be so abundant as to give the sensation of feeling a coarse sand-paper when the finger is passed over the area.

(3) **Placenta Accreta or Increta.** This is a very rare form of adherent placenta and is the result of imperfect development of the decidua or excessive proliferation of the chorionic epithelium, so that the villi invade the underlying musculature and even occasionally perforate through the uterus, reaching the peritoneal surface. There is no line of cleavage between the musculature of the uterus and the placental tissue and their separation is impossible, either naturally or artificially. This condition has been referred to in detail under post-partum hæmorrhage.

(4) **Tumours of the Placenta.** Chorioangioma is the commonest placental tumour. It varies in size from a few millimeters in diameter to the size of a foetal head at term and may be sessile or pedunculated. When the tumour is large, it is often associated with hydramnios. The tumour consists of enormously hypertrophied and dilated foetal blood vessels in the villi derived from a single villous stem. It may give rise to difficulty in the third stage of labour.

Other primary tumours of the placenta are extremely rare. Occasionally, cysts of the placenta may occur. They are usually small and of no clinical significance.

Anomalies of the Umbilical Cord

(1) **Length.** The normal length of the umbilical cord is about 50-60 cms. ; but great variations may occur. It may be very short or abnormally long. Variations between 15 and 100 cms. have been observed. Rarely the cord may be absent, the placenta being directly attached to the surface of the liver as in exomphalos. A short cord may give rise to dystocia for two reasons ; it may arrest the descent of the foetus and it may, by pulling on the placental site, cause premature separation. Occasionally, it may lead to inversion of the uterus.

An unduly long cord may give rise to the following complications :

(1) Presentation and prolapse of the cord.

(2) Knots and twists of the cord.

(3) Cord round the neck or the body several times. These anomalies may interfere with the foetal circulation and sometimes cause foetal death.

When the cord is round the neck several times, it often causes deflexion of the head, and occasionally the free length of the cord may

be so seriously diminished that it may interfere with labour just as a



FIG. 64.—Cord round the neck.

short cord would. As a result of obstruction to circulation, it may give rise to foetal distress *in utero*.

(2) **Insertion of the Cord.** The normal insertion of the cord

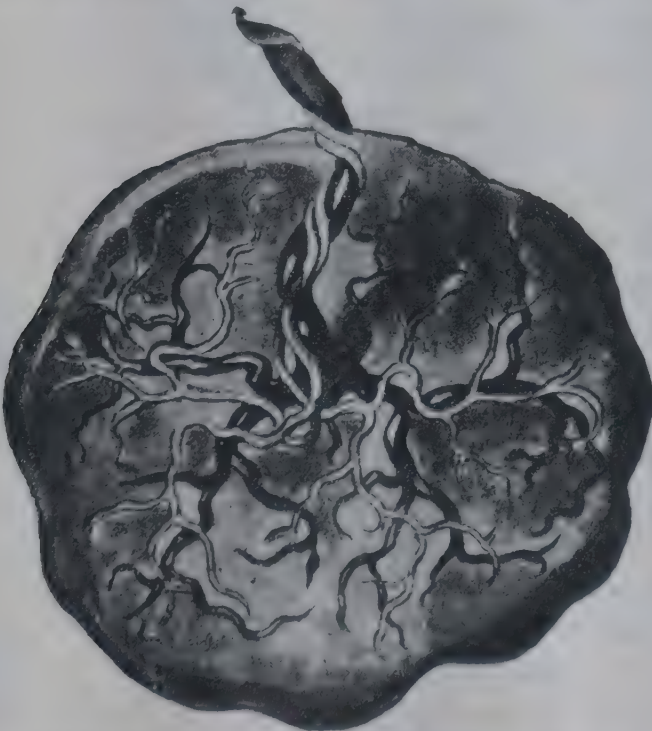


FIG. 65.—Normal placenta with almost central insertion of the cord.

is more or less near the centre of the placenta, but in some cases the

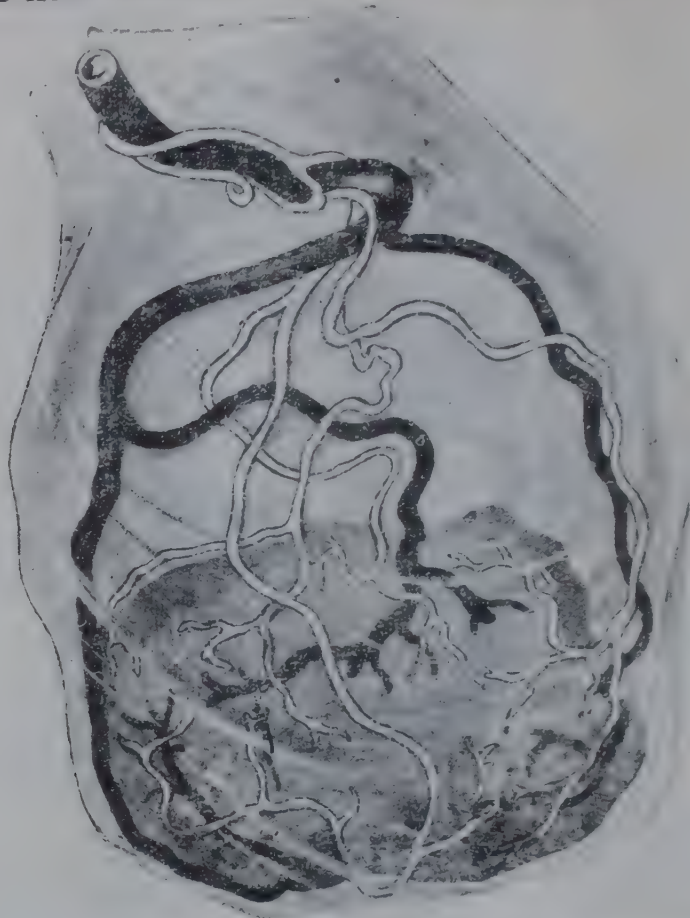


FIG. 66.—Velamentous insertion of the cord.

cord may be inserted at the margin of the placenta. This is known as a *Battledore Placenta*. In other cases, the insertion may be into the membranes and not into the placenta. Here the vessels of the cord pass between the membranes for a greater or lesser distance before reaching the placenta. This is known as a *velamentous* insertion of the cord. If this leash of vessels happens to lie in the bag of membranes in front of the os uteri—*vasa-prævia*—rupture of the membranes may involve one of the vessels and so cause hæmorrhage and death of the fœtus.

(3) **Knots of the Cord.** These are generally formed in consequence of fœtal movements. Knots may be either *true* or *false*. False knots are the result of a local increase of the Whartonian

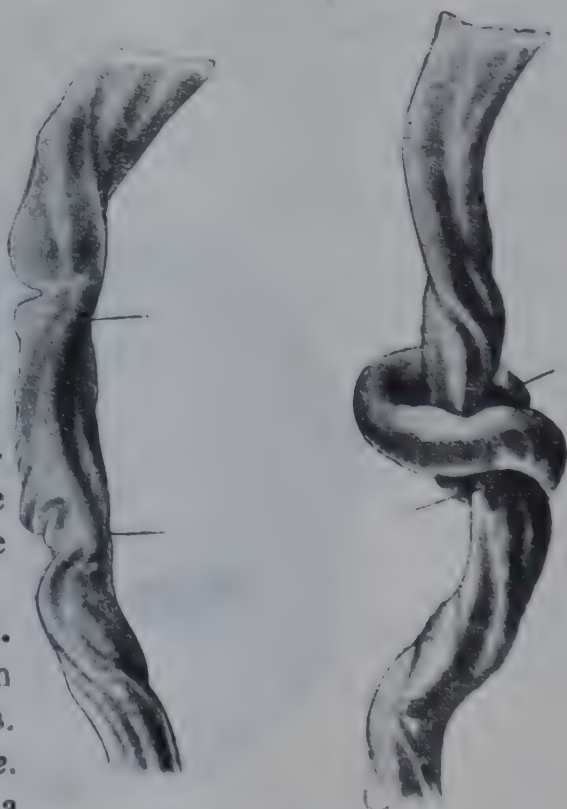


FIG. 67.—True knots.

jelly. A true knot, on the other hand, is due to a loop in the cord through which the fœtus has passed getting tighter and tighter. As a

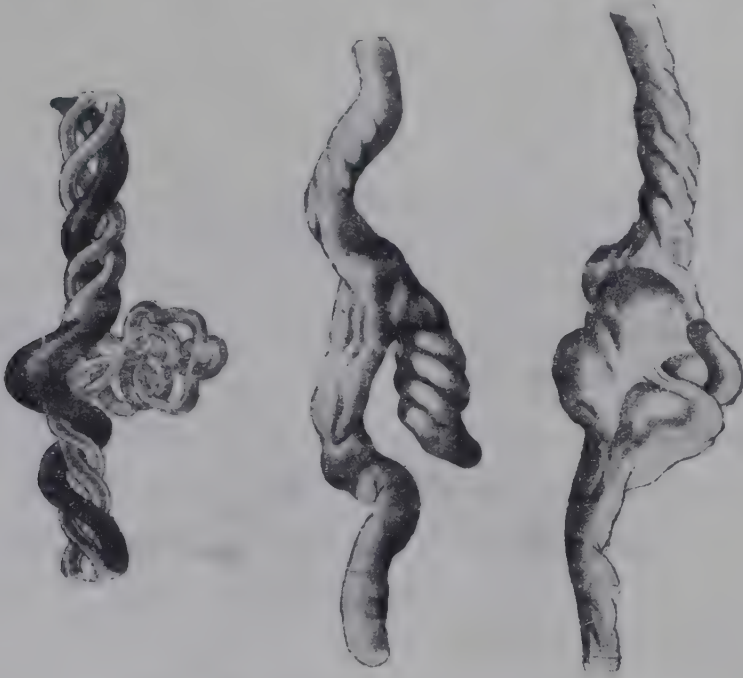


FIG. 68.—False knots in the cord.

rule, knots are harmless, since the constriction is rarely tight enough to obliterate completely the lumen of the vessels and thus obstruct the passage of blood. Where, however, obstruction is caused, it tends to interfere with the development of the fœtus and may even cause death of the fœtus.

Among the other anomalies of the cord may be mentioned loops of the cord, torsion of the cord where the cord becomes twisted and sometimes so seriously as to interfere with the circulation, inflammation of the cord, tumours of the cord and anomalies of the vessels.

These conditions are not possible of diagnosis; nor is there any prophylactic or curative treatment possible where they give rise to serious symptoms.

ABORTION is the termination of pregnancy before the fœtus becomes viable. Viability is usually reached at 28 weeks when the fœtus weighs slightly more than 1000 Gm. The World Health Organisation (1950) recommended the following classification concerning the tabulation of live births and fœtal deaths :

- (i) Less than 20 completed weeks of gestation—Group I.
- (ii) 20 completed weeks of gestation but less than 28—Group II.
- (iii) 28 completed weeks of gestation and over—Group III.
- (iv) Gestation period not classifiable in Groups I, II and III—Group IV.

Incidence. It is the most common serious complication of pregnancy and since it is not notifiable, it is difficult to get the accurate incidence. In general the incidence varies from 10-15%. In the Madras Government Maternity Hospital the average incidence is 11.3%.

Ætiological Factors. The ætiology of abortion is often complex and in many obscure. Investigations have shown that in many cases abortions occur as a result primarily of the death of the ovum and in others as a result of abnormal uterine activity. Various maternal, paternal and fœtal causes are said to be responsible or liable for bringing on abortion.

Fœtal Factors. Intrinsic defects of varying degree in the fertilised ovum result in clinical abortion. In over 60% of early abortions, such a defect has been discovered on microscopical examination of the aborted mass. Recent experimental work points to unsatisfactory uterine environment as being an important factor in the production of embryonic defects and faulty implantation. Embryonic defects have been produced by placing early embryos in abnormal environments or by subjecting them to unfavourable conditions of temperature or of oxygenation. There is a direct relationship between the problems of abortion and of malformation, the difference being only one of degree and the time of occurrence.

Cystic degeneration of the chorionic villi—hydatidiform mole—is a common cause producing primary death of the fertilised ovum and

abortion, and it is met with according to some in about 20% of the abortus examined.

Hæmorrhage into the decidua has been identified as an ætiological factor in a large percentage of spontaneous abortions. These are commonly seen in patients who start the abortion with painless bleeding. Infection of the placenta is another potent factor in producing abortion.

The importance of the sperm factor in relation to abortion should be remembered. A subfertile male can be responsible for abortion by failing to produce an embryo with sufficient urge to live. Placenta prævia is another cause of abortion. Low-lying placenta in the early and mid trimester very often produces an abortion. Rarely multiple pregnancy and hydramnios in the early months cause abortion. More often they result in premature labour. Umbilical cord anomalies occasionally produce foetal death and abortion.

Maternal systemic diseases may cause death of the foetus. Of these, the common important ones are acute infectious fevers, hypertension, chronic nephritis, syphilis and diabetes. Chronic nephritis and syphilis may produce sufficient placental infarction and necrosis to cause death of the embryo. However repeated abortions are uncommon in patients with syphilis. Hyperpyrexia in the mother can destroy the foetus.

Trauma in the early weeks of pregnancy often results in abortion. More often this trauma is in the form of an attempt at criminal or induced abortion. Severe hard labour, violent exercises and excessive sexual intercourse in the early weeks of pregnancy may bring about abortion.

Stress is laid on the importance of instability or excitability of the autonomic nervous system in the production of abortion. Psychogenic trauma in such cases may precipitate an abortion. Great emphasis is now laid on emotional factors.

Uterine Causes. Congenital malformations of the uterus play an important role in the causation of abortion, especially repeated abortion. While milder degrees of malformations may not interfere with pregnancy and very severe degrees may result in sterility, certain degrees and types of malformations of the uterus (septate uterus, bicornuate uterus) result in repeated abortion. It has now therefore become a routine procedure to rule out such malformations by hystero-gram while investigating cases of abortion.

Fibroid tumours of the uterus, especially if submucous, may not only interfere with conception but may also cause abortion. In quite a large number, however, the pregnancy may not be interfered with.

Much depends upon the size and position and number of these tumours. Endometritis has been found as an ætiological factor in about 10% of cases.

Retroversion of the uterus is very common and in quite a large number it does not give rise to trouble during pregnancy. But in some it may bring about abortion.

Ovarian tumours complicating early pregnancy may produce abortion, especially when torsion of the tumour occurs in the early months.

Hormonal. Hormonal imbalance may be the cause of fœtal death and abortion in a small number of cases. This type of abortion is often repeated and is habitual and hence will be discussed later under habitual abortions. Thyroid deficiency is an important factor.

Recently, cervical incompetence—insufficiency of the internal os—has been found to be responsible for a certain number of repeated abortions. This group also will be discussed later under habitual abortions.

Incompatibility of the Blood of Husband and Wife. When the mother's blood group is Rh negative and that of the father is Rh positive, the fœtal blood group may be Rh positive and may therefore hæmolyse on account of the immune isoantibodies formed in the maternal blood. The hæmolysis may cause fœtal death and late abortion or it may lead to the development of erythroblastosis fœtalisis in some. A.B.O. incompatibility may also be an ætiological factor.

Investigation of a Case of Abortion. Routine general examination should reveal the presence or absence of maternal diseases likely to cause abortion. These should include examination of urine and estimation of blood pressure. Serological examination will help in eliminating syphilis. Pelvic examination which should be done in all cases with great care will help in the diagnosis of uterine displacements, ovarian tumour or fibroid tumours of the uterus and at times congenital abnormalities and cervical incompetence. Especially in repeated abortions, after the abortion has taken place, a hystrogram should be taken some weeks later to rule out congenital malformation as a cause of abortion. Where laboratory facilities are available, estimation of Pregnan diol in the urine may help in the diagnosis of hormonal insufficiency. B.M.R., Protein-Bound Iodine (P.B.I.) and blood cholesterol determinations will help to rule out thyroid deficiency. If the patient aborts, it is desirable to have a histological examination of the aborted mass done.

Signs and symptoms. The signs and symptoms of abortion are : (1) pain due to uterine contractions, (2) hæmorrhage, as the result of separation of the ovum, (3) dilatation of the cervix due to the uterine contractions, and (4) expulsion of part or the entire ovum.

The patient generally gives a history of amenorrhœa followed by more or less severe pain in the lower abdomen and back accompanied by vaginal bleeding. The extent of the hæmorrhage varies and may sometimes be so considerable as to cause severe collapse. Usually, however, the hæmorrhage continues for some days, the quantity varying from day to day. The pain may be severe, but is never so great as in cases of ruptured ectopic gestation. Where pain and hæmorrhage are present, dilatation of the cervical canal may be present and occasionally a portion or the whole of the uterine contents may be expelled. Depending upon these signs and symptoms, the following types of abortions may be recognised :—

(1) *Threatened Abortion.* In this condition after a period of amenorrhœa, the patient complains of slight colicky pains in the lower abdomen associated perhaps with back ache, frequency of micturition and slight bleeding *per vaginam*. If a careful bimanual examination is made, the cervix will be found softened, the uterus enlarged and more or less globular, the size depending on the period of pregnancy. The os is generally closed or may in some cases be slightly patulous. Where there is no actual sign suggestive of death or expulsion of a portion of the ovum, the condition is known as threatened abortion.

(2) *Inevitable or incomplete Abortion.* This term denotes that the ovum has practically separated from the uterine wall and is therefore dead and bound to be expelled. In such cases the pain is more severe, the bleeding more profuse, the cervix is dilated, and occasionally a portion of the ovum may be felt protruding through the cervical canal. When only a part of the products of conception has been expelled it is termed incomplete abortion.

(3) *Complete Abortion.* This term is used when the whole of the ovum has been expelled. Once this has occurred, the pain subsides and bleeding decreases and may have stopped by the time the patient is seen. The uterus is empty and is accordingly smaller in size than the period of amenorrhœa would suggest and the cervical canal may be closed as it contracts very rapidly after complete expulsion of the uterine contents.

(4) *Cervical Abortion.* This is a somewhat rare form and is due to the expulsion of the products of conception from the uterus into the cervical canal where they are retained because the external os remains closed. There is a certain amount of pain associated with hæmorrhage.

After some time the bleeding may stop. On a vaginal examination the external os is found closed, but the cervical canal is ballooned out and is like an inverted cone due to the presence of the ovum therein.

(5) *Missed Abortion.* In this condition symptoms of abortion occur but subside later without any part of the ovum being expelled. The ovum dies but is retained in the uterus. The patient gradually recovers from the attack of pain and the vaginal hæmorrhage subsides. The hæmorrhage that has occurred *in utero* forms a clot round the dead ovum and changes take place subsequently in and around the ovum. In the early stages the clotted blood with the contained ovum presents a peculiar condition which is known as a blood mole. Later, when the blood clot becomes organised, the appearance changes, and in the course of a few weeks the whole of the uterine contents are changed into a dark red or brownish shaggy mass known as a *Carneous Mole*. Occasionally in these cases, owing to the formation of hæmatoma of varying size between the amniotic and the chorionic membranes, a further change takes place resulting in the formation of what is known as a *Tuberosc Mole*. Where a mole has developed the fœtus may not be present, or even if it does exist, it is of very small size. This is due to the fact that in the large majority of cases the mole formation takes place in the early weeks of pregnancy. Consequent on the long lapse of time before the mole is expelled, the fœtus may be absorbed or in some cases it may be found as a rudimentary vestigial structure. Where mole formation has taken place, the amenorrhœa may persist but none of the progressive signs of pregnancy are present. Thus the uterus does not continue to enlarge in size, the breast changes cease, the patient may not feel any of the subjective symptoms of pregnancy, and generally presents herself for the persistent amenorrhœa. A bimanual examination will reveal that the uterus though enlarged, never corresponds to the period of amenorrhœa, and is smaller, the cervical softening does not persist and the uterus itself does not have the soft feel of a normal pregnancy. If a pregnancy test be done at this stage, the result will be negative. Where the uterus is of a fairly large size, a röntgenogram may reveal the absence of a fœtal skeleton or if present will show radiological evidence of fœtal death.

(6) *Febrile Abortion.* Where signs and symptoms of abortion exist, with a rise of temperature, the condition is spoken of as febrile abortion. This may be due to two distinct factors :—

(a) In one set of cases the rise of temperature may precede the signs and symptoms of abortion and may be the causative or at least one of the causative factors. In such cases the usual symptoms of abortion are present—pain, hæmorrhage, etc., and the temperature is the cause and not the result of abortion.

(b) In other cases the rise in temperature may be due to sepsis, and the patient, besides presenting the usual symptoms of pain and hæmorrhage, will also have an offensive discharge *per vaginum*. This is called septic abortion.

The two conditions must be well differentiated as the treatment will differ with the particular type of febrile abortion.

(7) *Therapeutic Abortion*. Where abortion is induced as a therapeutic measure for the sake of the mother, it is spoken of as therapeutic abortion. The indications for therapeutic abortion are becoming more and more limited, and it is scarcely justifiable nowadays, except in the presence of some very definite factor, to resort to therapeutic abortion. In modern obstetrics there are few indications for therapeutic abortion. Pulmonary tuberculosis in pregnant women is now no longer considered an indication for therapeutic abortion. Cardiac disease (Grades III and IV) and decompensation in a previous pregnancy are justifiable indications for termination of pregnancy in the first trimester. It is necessary that optimum compensation be established prior to termination. Epilepsy and other forms of psychosis in the mother who has had a number of children may justify a therapeutic abortion. Intractable hyperemesis gravidarum will necessitate termination of pregnancy. If the mother contracts german measles in the early weeks of pregnancy, some advocate induction of abortion on the plea of a malformed fœtus being born. Chronic glomerulonephritis, malignant hypertension, pregnancy following soon after a radical mastectomy for carcinoma of the breast, are other indications. It is advisable in all cases where a therapeutic abortion is considered to have a second medical opinion.

Chromosomal and enzyme abnormalities have now been identified as factors responsible for transmission of certain inherited disorders. Some of these disorders may also be sex-linked. It is possible to determine by examination of the liquor amni whether the intra-uterine fœtus will be affected, or not. If investigations yield a positive result, it is now the practice to induce abortion. Sex-linked diseases like hæmophilia, progressive muscular atrophy and chromosomal abnormalities resulting in various genetically induced disease can now be diagnosed early as also Iatrogenic disorders and therapeutic abortion performed.

(8) *Criminal Abortion*. This term is applied where abortion is induced with a criminal intention. According to the law of the land it is an offence to interfere with pregnancy for any reason other than therapeutic, and even then not unless a second medical opinion favours such a measure. Criminal abortion, unfortunately, is practised in most

countries and is one of the potent factors in the causation of maternal mortality and morbidity.

Diagnosis. Uterine abortion has to be differentiated from :—

- (1) Functional menstrual disturbances.
- (2) Carcinoma of the cervix.
- (3) Ectopic gestation.
- (4) Hydatidiform mole.

In functional menstrual disturbances the woman has irregular menstruation. There may be amenorrhœa for periods varying from six to twelve weeks but the history is generally suggestive. A profuse bleeding occurring at the end of that period may suggest the possibilities of an abortion, but a careful bimanual examination will reveal absence of signs of pregnancy. In case of doubt a pregnancy test will be helpful.

Occasionally carcinoma of the cervix may co-exist with pregnancy and the bleeding from the cancer may be mistaken for that due to abortion. Vaginal and speculum examination will clear the doubts when the cervical cancer can often be diagnosed. Biopsy will confirm the diagnosis in early cases.

Difficulty is often encountered in differentiating uterine abortion with a retroverted gravid uterus from an unruptured ectopic gestation or tubal abortion with a pelvic hæmatocele. In the two latter conditions there may be a history of a short period of amenorrhœa with occasional attacks of colicky pain in the lower abdomen and vaginal bleeding which is seldom profuse. Vaginal examination often reveals a uterus smaller in size than the period of amenorrhœa would warrant and an extremely tender mass in one or other of the fornices or the Douglas's pouch separate from the uterus. Blood can most often be aspirated from this mass through the posterior fornix, thus helping to clinch the diagnosis.

In vesicular mole the uterus is often bigger than the corresponding period of amenorrhœa. The pregnancy test is positive in high dilutions and examination of any products passed per vaginum may reveal vesicles.

Prognosis. The prognosis depends upon any complication that may be present. Usually the bleeding is not marked, and the expulsion of the products of conception may take place spontaneously without any undue risks to the mother. In some cases, however, severe hæmorrhage and collapse may result, and if not attended to in time may entail grave risk to life. Where abortion is complicated with other

conditions, or is a result of general or constitutional diseases, the prognosis is rendered worse. The patient may recover from the effects of abortion but certain sequelæ may persist, such as subinvolution, displacements of the uterus and adnexal troubles.

Prophylaxis. Whenever there is a history of previous abortion, the patient should be carefully examined along the lines which have been indicated. In many cases, if conditions likely to cause abortion, are treated prior to pregnancy, abortion may not occur. In particular, attention must be drawn to the possibility of syphilitic infection, septic foci, endocrine disturbances and deficiency diseases.

Treatment. *Threatened Abortion.* Complete rest in bed is essential. Vaginal examination should be performed with great care and gentleness. Sedatives to relieve pain and anxiety of the patient are indicated. Morphia 16 mgm. or any barbiturate or other groups of sedatives could be given. It should be repeated as and when necessary. The bladder should be kept empty. Purgatives must not be administered. A small glycerine enema to empty the lower bowel is all that is required. It is very necessary that the patient be at rest in bed till the bleeding and pain have been completely absent for at least a week.

Administration of œstrogens and progesterone has been recommended by some in the management of threatened abortions. Where a hormonal deficiency has been demonstrated—which is usually progesterone deficiency—administration of progesterone is useful. This can be given either orally as ethisterone tablet 30 mgm. daily or as intramuscular injections 25 mgm. of progesterone daily. The hormone therapy will have to be continued for a week or ten days after all signs of abortion have completely disappeared. Œstrogens are said to help by improving the vascularity of the uterus and also by stimulating the production of progesterone. 15-30 mgm. of Stilboestrol daily by mouth or even larger doses have been advocated. Very potent oral progestational compounds are now available—19 non-steroids and allied compounds. These can be given orally when indicated with satisfactory results. The value of these lines of treatment in the management of ordinary threatened abortion is controversial. It is necessary to bear in mind that the administration of some of the progestational compounds may give rise to ambiguous genitalia in the new-born.

Threatened abortion becomes an inevitable one when there is profuse bleeding with dilatation of the cervix permitting palpation of the ovum, when portions of the products of conception are expelled and when the uterine contents are infected.

In such cases the treatment is that of inevitable abortion.

Inevitable Abortion. In these cases the abortion is bound to occur, but the question is whether any active interference is indicated or not. No definite rule can be laid down. In the majority of cases inevitable abortion will end spontaneously. On the other hand, in the presence of severe hæmorrhage or repeated small hæmorrhages or if a portion of the ovum has actually been passed out and the cervix is gaping, it is necessary to evacuate the uterus. In those cases where interference is indicated, evacuation either digital or instrumental is the treatment. This should be carried out under anæsthesia and strict aseptic precautions. Prior to starting the evacuation, Methergine 0.25 gm. given intravenously will help in diminishing the blood loss. If the cervix is dilated sufficiently to admit a finger freely, and if the period of amenorrhœa is within twelve to fourteen weeks, the ovum is separated gently from the uterine wall by the finger. The procedure



FIG. 69.—Digital evacuation of the uterus.

will be considerably facilitated by the other hand applied suprapubically pressing the fundus downwards so that it is brought within reach of the vaginal finger. If the ovum has been entirely separated, it may be removed by expressing it manually, or if this is not possible, it can be removed by ovum forceps or sponge forceps. Where the cervix is not sufficiently dilated, preliminary dilatation is necessary. After

the cervical canal has been dilated up to the largest size by Hegar's or Mathew Duncan's dilators, a finger is passed and the ovum gently separated. Care must be taken in dilating the cervix and in separating the ovum to prevent perforation of the uterus. The ovum thus separated is removed either by ovum forceps or by the sponge forceps. With gentle twisting and light traction the whole of the ovum can be removed with ease. It is advisable to gently curette the uterus as by this measure any remnants adhering to the uterine cavity will be removed. If done with care, the danger of perforation of the uterus is negligible. Often blood transfusion may be required to combat the hæmorrhage and shock. The patient is returned to bed and the subsequent care is similar to that given in the puerperium after normal labour. In cases of inevitable abortion where there is no urgency due to hæmorrhage, fractional doses of Oxytocin (5 units every half hour for 4 or 5 injections) or 20 units of Oxytocin in 500 cc. of 5% glucose given as a drip at a rapid rate to promote uterine action and spontaneous expulsion is worth a trial. We are, however, of the opinion that surgical evacuation is better in these cases.

Where the cervix is hard and not easily dilatable, and where the signs and symptoms point to a rapid evacuation being necessary, evacuation of the uterus by vaginal or abdominal hysterotomy would be necessary. In all cases after evacuation, prophylactic antibiotic therapy should be instituted. Where there has been heavy bleeding, the loss should be replenished by blood transfusion. In the rest, in the post-abortion period iron by mouth will help to combat any anæmia present.

Missed Abortion. The treatment of missed abortion is the same as that of intra-uterine death of the foetus and retention and is discussed in detail under that head.

Septic Abortion. In this condition infection has taken place and the abortion is inevitable. There is usually pyrexia of varying degrees and the physical signs depend upon the severity and spread of infection. It may be classified clinically into three grades :—

Grade I—Here the infection is entirely limited to the uterine cavity (local infection). Pyrexia of varying degree, but not high, is present ; there is an offensive vaginal discharge and the patient's general condition is satisfactory. Abdominal palpation may reveal slight tenderness over the uterus confined to the hypogastrium and vaginal examination may show a partially open cervix or a closed one with a bulky tender uterus. The fornices will be free of any masses or tenderness.

Grade II—In this group the infection has spread beyond the uterus into the parametrium. The patient is more acutely ill. The lower abdomen is slightly rigid and tenderness is present over the

hypogastrium and on either side. Vaginal examination reveals a tender adnexal region and diffuse fullness with a bulky uterus.

Grade III—In this group the patient is very ill with signs of peritonitis : fever, dry tongue, rapid pulse, distended abdomen and marked tenderness all over.

It is safe not to interfere with pregnancy in the absence of hæmorrhage. In Grades II and III the patient should be treated as for peritonitis. 5% glucose saline as a continuous intravenous drip 3-4 pints a day to control dehydration is essential. Antibiotics must be administered as a rule. Broad spectrum antibiotics should be used where facilities for testing sensitivity of the organism do not exist. The organisms usually concerned are Staphylococci and B. Coli. Tetracycline 500 mgm. by intravenous drip is very useful in Grade III cases. Else 250 mgm. orally every six hours is recommended. Penicillin 400,000 units with 1 gram of Streptomycin daily may be tried instead. The treatment with antibiotics may have to be continued for a week and no interference is attempted in the absence of hæmorrhage till the temperature has come to normal and the patient has become free of all pain and tenderness at least for a week. Most of these cases require blood transfusion also. In Grade I cases, where the infection is confined to the uterus and the cervix partially open, the infected abortus may be removed with the finger, if possible under antibiotic coverage (Penicillin and Streptomycin).

Sometimes the infection is resistant to Tetracycline in which case Chloramphenicol may be tried with better results.

In some cases, as a result of infection, a pelvic abscess develops. If it does, it should be drained by colpotomy or if the abscess points over the abdominal wall, it should be drained at the site where it is pointing.

Infection is a grave complication in abortions. While in the majority it may respond to treatment easily in some with severe infection the prognosis is grave. Shock and anuria may develop suddenly in these patients. It is believed to be due to bacterial endotoxins liberated into the maternal circulation from the infected products resulting in shock and anuria from occlusion of the afferent glomerular capillaries by fibrin (Schwartzmann's reaction). This phenomenon is more common when the organism concerned is Cl. Welchii. In these cases of Cl. Welchii infection apart from shock, jaundice, hæmaturia due to intravascular hæmolysis and anuria may be observed.

The treatment consists in controlling shock by transfusion with compatible blood if there has been severe hæmorrhage, followed by intravenous administration of broad spectrum antibiotics—Tetra-

cycline or Chloramphenicol (250-1000 mgm.) as a drip in 5% glucose saline. Large doses of Penicillin—million units daily can also be employed. Cortisone 250 mg. or more every four to six hours administered intravenously is helpful. Where the blood pressure continues to be low 2.5 mgm. of noradrenaline in 500 cc. of 5% glucose or glucose saline administered intravenously as a drip is of value. The assessment of the degree of shock and the amount of fluids administered intravenously is best regulated by monitoring the central venous pressure. In cases with Cl. Welchii infection antigas serum—100,000 units intravenously and repeated 50,000 units daily—should be administered. Renal failure should be treated on the lines discussed previously. It is doubtful whether hysterectomy will save these cases though some successful cases have been reported.

In spite of antibiotics the mortality from infected abortion, which is mostly the result of criminal attempts, is high and accounts for 20% of maternal deaths due to direct obstetric causes.

Post-abortion anuria due to injection of solutions into the uterine cavity to produce abortion is not an uncommon occurrence. These solutions usually produce hæmolysis by entry into the maternal circulation through maternal venous sinuses in the decidua and give rise to renal failure. The prognosis is grave and treatment is on the lines of renal failure.

Post-Abortal Tetanus. Tetanus occurs more frequently after abortion than after full term delivery and more often after criminal than after spontaneous abortion. Onset of symptoms occurs between the sixth and twelfth post-abortion day, though occasionally symptoms have been reported earlier in rare instances occurring immediately after termination of pregnancy.

The following routine treatment may be adopted. The patient is placed in a quiet room shielded from noise and external stimuli. Chlorpromazine 25 mgm. intramuscularly every 6 hours is very useful in controlling spasms along with other sedatives. This is repeated at sufficiently frequent intervals to maintain a narcotised state until all danger of spasms has passed. The patient is tested for sensitisation to antitetanic serum. Antitetanic serum is then administered: 50,000 units intramuscularly, and 50,000 intravenously. If the incubation period has been short or if symptoms are severe, administration of 50,000 units of antitetanic serum by both routes may be continued on each of the next few days. Penicillin is also useful in these cases.

Complications : *Perforation of the uterus during evacuation*, especially when the uterus is retroverted or retroflexed, is not an infrequent occurrence and may be responsible for a fatal termination by causing hæmorrhage and peritonitis. When perforation is suspected,

further procedures must be discontinued. The patient's blood pressure and pulse should be watched. If signs of internal bleeding are evident, immediate laparotomy should be done. Depending upon the size of the perforation, a repair of the rent or hysterectomy will be indicated. If no signs of internal bleeding are present, the patient might develop peritonitis later and therefore antibiotic therapy should be started and expectant line of treatment carried out.

Hæmorrhage is another common complication and may sometimes be alarming. Intravenous Methergine or Ergometrine and blood transfusion will suffice in the majority, to control the blood loss.

Another complication is where the operation has not resulted in a complete evacuation of the uterus. When small bits of placenta are left behind, they may give rise to irregular vaginal bleeding, and occasionally a placental polypus may form at a later date. They may also give rise to secondary infection. Where a portion of the foetus itself is left behind, decomposition is bound to occur, resulting in septic discharge, elevation of temperature, passage of small bits of the foetal remnants associated with increasing pain and discomfort. Treatment is along the lines already indicated for incomplete abortion. Bilateral cornual block resulting in sterility is a common sequela of infected abortions.

A mistake which is so tragic in its results is to curette the uterus in cases of ectopic gestation. This is referred to in the chapter on extra-uterine pregnancy. Immediate laparotomy is the only possible method of dealing with that condition.

Habitual Abortion. This is one of the most perplexing problems in obstetrics. While an occasional abortion in the course of reproductive period is extremely common, there is a small group which aborts repeatedly at a particular period in pregnancy. To this group the term habitual abortion is applied. The incidence of habitual abortion is about 0.4%.

A woman is said to be a habitual aborter if she had three or more consecutive abortions. She is termed a primary habitual aborter when she has never had a successful pregnancy and a secondary habitual aborter if the consecutive abortions follow one or more successful pregnancies.

The ætiology of this condition is obscure. Commonly the abortion occurs about the 10th to 12th week of pregnancy. Routine investigations and examinations usually reveal no pathology, though in some cases congenital malformations of the uterus have been discovered. It is therefore very necessary in all such patients to do a hystrogram in the non-pregnant interval and any abnormality dis-

covered corrected. Thyroid deficiency should be looked for and the P.B.I. and blood cholesterol determined. Pregnandiol estimation during pregnancy in some cases shows low values and hence, in some, diminished progesterone may be an ætiological factor.

Œstrogens and progesterone are very essential for proper nidation and development of the fertilised ovum. The very large amounts of chorionic gonadotrophin secreted by the cytotrophoblast in early pregnancy stimulates the corpus luteum to produce more œstrogens and progesterone. At a later stage the placenta takes over the function of producing the steroid hormones and this usually about the 12th week. It is at this particular critical period that most of the habitual aborters expel the ovum. Hence many believe habitual abortion is due to lack of steroid hormones particularly progesterone. Investigations have not fully justified this view. It has however been proved that some cases of habitual abortion are due to poor progesterone production. Syphilis seldom gives rise to habitual abortion.

The treatment of these cases is a problem. Despite all treatment many abort and an equal number perhaps have successful pregnancies without any definite treatment after a number of abortions.

It is customary to give these patients hormones as soon as conception occurs. Ethisterone 10 mgm. three times a day by mouth or any of the now available more potent oral progestational compounds of the 19-norsteroid and allied group up to the middle trimester or 25-50 mgm. of progesterone twice a week intramuscularly till about the 30th week is recommended. Instead some recommend implantation of 150 mgm. of progesterone deep in the gluteal region as soon as conception occurs. In recent years better results are reported by the use of long acting progesterones—17 alpha hydroxyprogesterone caproate—(Dela Leutin) 250 mgm. injected deep intramuscularly once a week for 12 weeks is said to give very satisfactory results as compared to other methods of therapy. Thyroid 1 grain twice a day orally is said to help. Rest in bed particularly during the period at which abortion occurs is essential. Vitamin E is said to be of benefit. Psychotherapy is useful.

Insufficiency of the Internal Os. There is a certain group of patients in whom abortion occurs usually between the 16th and 28th weeks. They give a typical history of sudden rupture of the bag of waters followed by uterine contractions and expulsion of the fœtus and placenta. This repeats itself in successive pregnancies. Vaginal examination during pregnancy reveals a patulous cervix with the internal os open and the bag of membranes bulging. In this group of cases the abortion is attributed to lack of sphincteric action of the internal os or as it is sometimes termed cervical incompetence. This

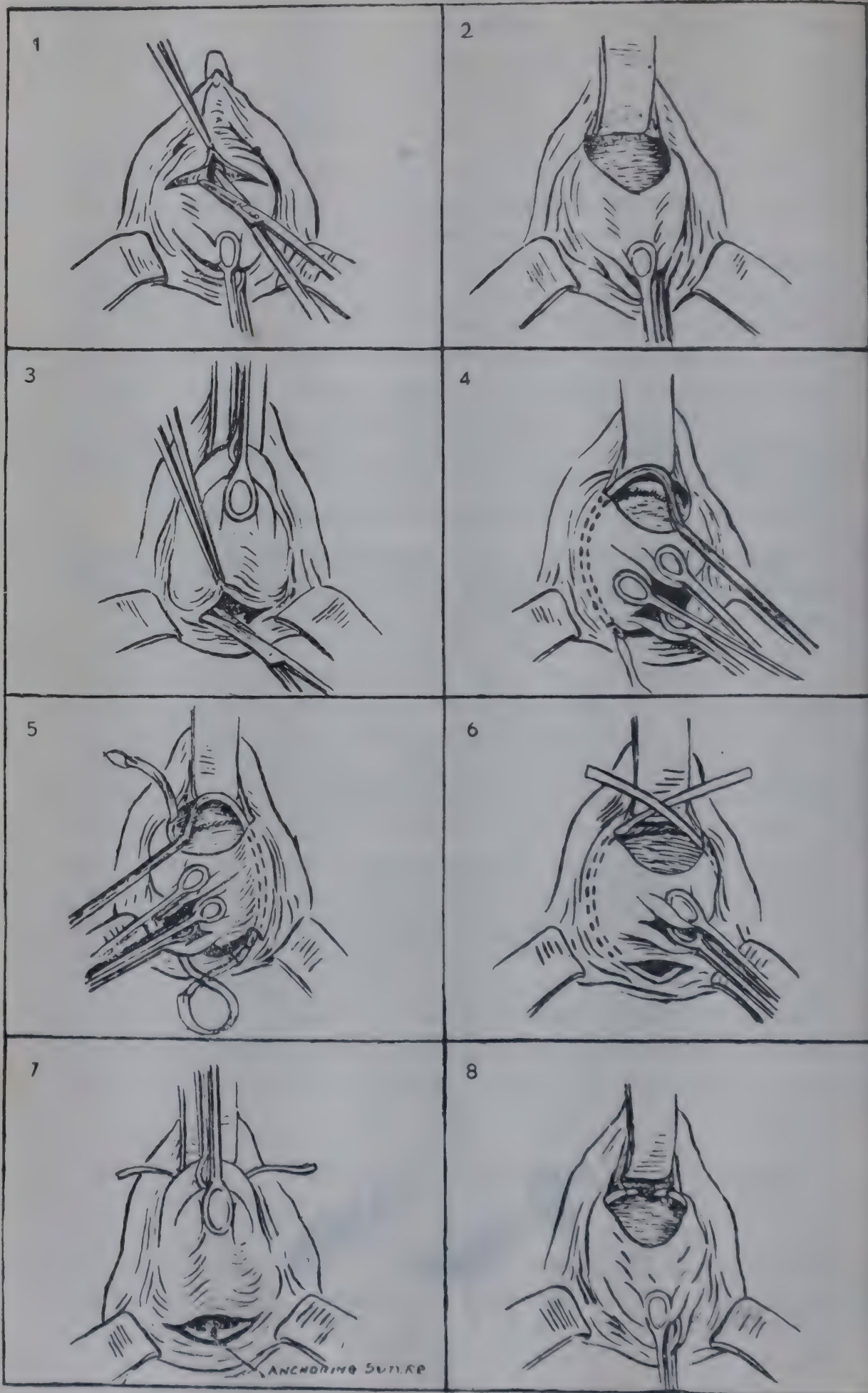


FIG. 70. (For description of the figure vide bottom of opposite page.)

incompetence may be a congenital weakness or acquired as a result of surgical operations—forcible dilatation of cervix, high amputation of cervix, or due to laceration. Whatever be the ætiology, the clinical history is characteristic. In the non-pregnant patient with this history, examination shows that a No. 8 or 10 Hegar's dilator can easily be passed into the uterine cavity. Hysterography reveals a broadening in the region of the isthmus. During pregnancy the typical bulging of the bag of membranes is characteristic.

The treatment of the condition is now surgical. It can be undertaken during pregnancy or in the non-pregnant interval. Various operations have been described. Dr. Shirodhkar who was the first to perform the operation in pregnancy tightens the region of the internal os by encircling the whole of the cervix at the level of the internal os by a strip of fascia lata. The important steps of the operation are as follows :—

After the vagina has been gently prepared with an antiseptic solution, the cervix is visualised. An ovum forceps is used to grasp the anterior lip of the cervix. The vaginal mucosa is opened anteriorly in a transverse manner by scissors dissection. The incision should be about an inch in length. By means of sharp and blunt dissection the bladder is then displaced upward of the cervix as high as is possible. The posterior lip of the cervix is then grasped with an ovum forceps and an incision is made in the mucosa overlying the posterior portion of the cervix. That incision can usually be made 2 inches above the level of the external os. The incision is also about an inch in length and is made transversely. A large specially made aneurysm needle is introduced through the anterior incision and directed downward around the right lateral aspect of the cervix to emerge through the posterior incision. The fascial suture is then applied to the aneurysm needle and as the needle is retracted it brings the leading end of the fascial suture out through the anterior incision. A second aneurysm needle which is the mirror image of the first is then introduced into the anterior incision on the left. It is directed downward along the

FIG. 70.

- (1) By a transverse incision the anterior vaginal mucosa is opened.
- (2) The bladder has been advanced to the level of the internal os of the cervix.
- (3) The posterior vaginal mucosa is being opened about 1½-2" above the external os.
- (4) The special aneurysm needle is being passed through the anterior incision so that it emerges posteriorly to pick up the fascial strip.
- (5) The same is being done on the other side—the other end of the fascial strip is picked up.
- (6) The fascial strip is now brought over the front of the cervix at the level of internal os.
- (7) Fixing the fascia posteriorly to the cervix.
- (8) Tightening the fascial strips and fixing it to the front of the cervix.

lateral aspect of the cervix emerging through the posterior incision on that side. The remaining end of the suture material is fastened to the aneurysm needle and the needle is withdrawn along the left side of the cervix so that the strip of fascia now encircles the cervix. The strip of fascia is anchored posteriorly to the cervix by means of a silk suture. Fixation of the fascia prevents it from slipping over the posterior lip of the cervix. After it has been pulled up tightly around the cervix, the strip is then tied. After the knot has been tied it is held securely by 2 or 3 silk sutures deeply imbedded in the anterior cervix. The anterior and posterior vaginal mucosal incisions are then closed. No packing is placed in the vagina because there is usually no bleeding after the mucosa has been sutured. At the completion of the operation the fascial strip should be at level of the internal os.

The patient is then seen at intervals of 2 weeks. A vaginal examination is done at each such visit to visualize and to palpate the cervix.

Most of these cases are later delivered by cæsarean section. Dr. Shirodhkar reports 80% successful pregnancies with this line of treatment. Various other suture materials to encircle the cervix—silk, nylon, dacron-mesh—are now employed. The principle however is the same. One of the disadvantages of using fascia lata is that all deliveries have to be by cæsarean section. On the other hand if silk, nylon or dacron-mesh is used it can be cut when labour starts. Though vaginal delivery is thus attained, should the patient be desirous of having another child the whole process will have to be repeated.

It should also be remembered that in some cases more than one factor may be present—a person with cervical insufficiency may also harbour a factor producing habitual abortion.

Intra-uterine Death of the Fœtus

For the proper maintenance of the fœtus *in utero* an adequate supply of oxygen is extremely essential. This oxygen supply is obtained through the placental circulation, the requisite amount reaching the fœtus through the umbilical vein and returning to the placental circulation through the umbilical arteries. The environment of the fœtus *in utero* is such that the partial pressure of oxygen in its intra-uterine life is such as is available at an altitude of 33,000 feet which is only about 35-40 mm. of Hg. This is a pressure which would kill an adult in a few minutes. Why nature has chosen such a medium for the fœtus to live is a mystery. The fœtus however thrives in such an environment by a process of adaptation and accli-

maturation as is seen in mountaineers. The most noticeable feature is the increased hæmoglobin concentration. The average concentration of hæmoglobin at birth is approximately 20% higher than in adults. A still further protecting mechanism is the fœtal hæmoglobin which is of a special kind and is of such a nature that it gives off oxygen more easily and more readily and gram for gram takes in more oxygen than adult hæmoglobin. It has also been observed—though there is controversy on this point—that as pregnancy reaches term there is a gradual fall in the oxygen supply to the fœtus but seldom sufficient to cause distress. If however pregnancy continues beyond term for over three weeks the oxygen supply falls to critically low levels giving rise to fœtal distress which is manifested in the form of escape of meconium into the liquor.

From what has been stated above it will be evident that any factor which brings about a diminution in the supply of oxygen to the fœtus *in utero* can produce fœtal anoxia and death of the fœtus. Such factors may operate in pregnancy prior to labour or during labour and when it operates in labour, if the fœtus is born alive, it may result in asphyxia and neonatal death. The problem of asphyxia is discussed later.

Ætiology of Fœtal Anoxia. (1) Maternal conditions which render maternal blood anoxic—anæmia, heart disease, pulmonary diseases, etc.

(2) Diminished blood supply to the decidua due to hypertension, pre-eclamptic toxæmia and eclampsia, chronic glomerulonephritis, diabetes, or syphilis.

(3) Placental pathology—placenta prævia, premature separation of the placenta, diseases of the placenta.

(4) Obstruction to circulation in the cord—cord compression, true knots.

(5) Obstruction in fœtal circulation—developmental anomalies.

(6) RH isoimmunization.

(7) Post-maturity.

(8) Other causes—Acute infectious fevers.

(9) Habitual intra-uterine death of the fœtus—No satisfactory explanation has been found for this condition, wherein repeatedly the fœtus dies *in utero* at a particular period in pregnancy.

Diagnosis. This is based on the history and clinical findings. In most cases a history of cessation of fœtal movements and failure of growth of the uterus with progressive amenorrhœa is obtainable. Clinical examination reveals a uterus smaller than the period of

amenorrhœa, and the absence of foetal heart sounds if intra-uterine death has occurred sometimes before. Confirmatory evidence can be had by radiography and laboratory tests for pregnancy. Of these, radiography gives the earlier evidence. The signs of foetal death in X-ray are (1) Spalding's sign, (2) a crumpled up foetus with its spines angulated and ribs crowded together and (3) sometimes free gas in structures corresponding to the foetal aorta.

The best known sign—Spalding's sign—consists of an overlapping of skull bones. It may however occur with a living foetus either during labour or when liquor amnii has escaped and foetal head is compressed in the true pelvis. The sign results from maceration of the foetal head and may be observed as early as 48 hours after death of the foetus. A high degree of curvature of the spine results from maceration of the trunk and in extreme cases the foetus may appear rolled up like a ball. Presence of gas in the foetal vascular system is a certain sign of intra-uterine death. Analysis has shown that the gas is probably nitrogen.

Treatment. In a large number of cases the ætiology is obscure. In cases where the foetus dies habitually *in utero* in the last weeks of pregnancy an attempt to save the foetus may be made by induction of premature labour or cæsarean section. Prolongation of pregnancy over two weeks beyond term, is, in the opinion of many, disadvantageous, and hence labour may be induced to avoid unexplained still-births. There is no proof that hormones are definitely helpful in preventing intra-uterine death but where such a deficiency is demonstrated—usually progesterone deficiency—this hormone may be tried.

Once intra-uterine death has occurred whether it be prior to or after viability it is not necessary to attempt evacuation of the uterus forthwith. In the majority, within three to eight weeks, the uterus expels the contents spontaneously. Some cases develop mild symptoms of toxic absorption like nausea, vomiting, low grade fever and pus cells in urine, in which case interference is indicated.

In recent years the retention of a dead foetus for a long time has been found to give rise to coagulation defect in the mother. As a result of the entry of thromboplastin from the dead placenta into the maternal circulation, the fibrinogen in the blood is used up and its level begins to drop till ultimately it falls to low levels and even afibrinogenæmia may develop. This results in severe uncontrollable hæmorrhage when the uterus is emptied. It is observed that coagulation failure seldom occurs earlier than three weeks after intra-uterine death and is more common after five weeks. The awareness of this complication has altered the management of these cases. It also

happens that most mothers are averse to carrying a dead fœtus and request emptying of the uterus. As spontaneous expulsion is very common, retention of a dead fœtus for longer periods than five weeks should arouse the suspicion of the pregnancy being extra-uterine and it should be the duty of the obstetrician to review the case and confirm the diagnosis of intrauterine death in such cases of prolonged retention.

After intra-uterine death has occurred, no harm is done if the patient is left alone for two or three weeks. No harm is done either if, in the meanwhile, an attempt at evacuation is made by medical induction which consists in the administration of an intravenous oxytocin drip—10 to 20 units in 500 ml. of 5% glucose—the drip being given at a rate which brings on sustained uterine contractions. It may succeed. If not, it can be repeated two to three days later or spontaneous expulsion awaited.

In any case, after the third week, the blood fibrinogen levels should be estimated to watch for hypofibrinogenæmia. Such estimations should be performed every week, if not twice a week, and when fibrinogen level begins to fall and the uterus is still not evacuated spontaneously it would be advisable to bring up the fibrinogen level to normal by blood or plasma transfusions (fibrinogen may be given if available) and then the uterus emptied.

When a decision has been taken to empty the uterus, the method employed depends upon the size of the uterus and the nature of the cervix. In these cases the cervix is usually hard and ordinary methods of dilatation and evacuation hazardous. Dilatation by the introduction of laminaria tents and promotion of uterine action by intravenous oxytocin drip may be tried. The procedure may succeed. If it fails, either vaginal or abdominal hysterotomy may have to be performed. In fact, some of these cases bleed so profusely during dilatation and evacuation that in cases not responding to induction and where spontaneous expulsion has not occurred it is advisable to evacuate by hysterotomy.

In 1962 Bengtsson and Csapo used intramniotic injection of hypertonic 20% sodium chloride to induce abortion successfully in women between 16th and 24th week. They observed in their studies a marked fall in blood and placental progesterone levels after the intramniotic injection. Other workers using 50% glucose solution also reported successful results.

Our experience with this form of therapy has been very satisfactory.

The procedure adopted is as follows:—After having decided to empty the uterus, with all aseptic precautions, 50% glucose solu-

tion mixed with 100,000 units of Penicillin and 1 gm. of Streptomycin is injected into the amniotic cavity per abdomen using a thick aspirating needle (Gauge 18 and length 4"). Prior to injection of the solution after amniotomy as much liquor as possible is withdrawn. The amount of solution then injected through the needle varies in each case depending upon the amount withdrawn. Always a quantity more than that withdrawn is injected. After the injection the patient is kept in bed till the pains start.

There is always a time lag from the time of injection to the onset of pains which varies from 4-72 hours. The injection delivery interval ranges from 7 hours to 80 hours, the average being 20 hours. In 72 of 75 cases the delivery was completed within 48 hours, in 2 within 72 hours and in one in 80 hours. The complication that is most likely to be encountered is infection. Especially if glucose is used it is said that more severe infection is likely to follow.

Injection of hypertonic saline may give rise to complications in cases of toxæmia and in such cases perhaps hypertonic glucose is preferable. However we must state that so far our results have been very satisfactory with only 2 failures and no untoward reactions or even mild infection has been observed. In the two failures the delivery was completed by using oxytocin drip. From our experience we conclude that intramniotic injection of hypertonic glucose or saline to empty a pregnant uterus is a reasonably safe and effective procedure. It must be remembered that intramniotic injection of these solutions results in foetal death if it is alive and should not be used in cases where there is a chance of foetal survival if it is born alive. In such cases other methods should be preferred.

It is emphasized that spontaneous evacuation occurs in most of the cases and that no harm is done by awaiting such an event for three to five weeks after the death of the foetus. After this period it is safer to empty the uterus. The majority can be dealt with by medical induction and vaginal evacuation. A few may require vaginal or abdominal hysterotomy. The dangers of coagulation failure should be borne in mind.

ECTOPIC PREGNANCY

IN ectopic pregnancy the fertilised ovum develops at a site outside the uterine cavity. The term 'extra-uterine' is also sometimes applied to those rare conditions where pregnancy occurs in a uterine horn or where it occurs in the interstitial portion of the tube and impinges on the uterine cavity.

Varieties. The chief varieties are:—

- (1) Ovarian pregnancy.
- (2) Abdominal pregnancy—primary or secondary.
- (3) Tubal pregnancy.
- (4) Pregnancy in a rudimentary uterine horn.

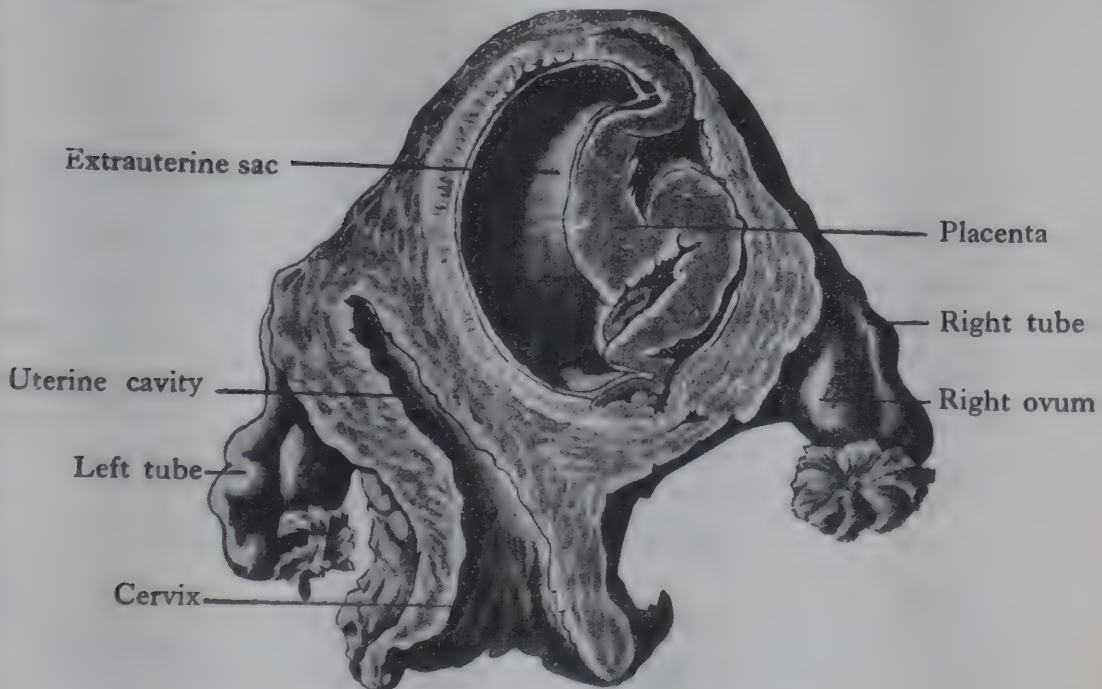


FIG. 71.—Section of an interstitial pregnancy.

When an extra-uterine pregnancy occurs in the Fallopian tube, it may be situated in the interstitial, isthmal, ampullary or infundibular portion.

Ovarian Pregnancy

This is a very rare occurrence, but several cases of true ovarian pregnancy have been reported in the literature.

Fertilisation occurs in the Graafian follicle, so that the fertilised ovum, implants itself directly into the ovarian tissue. Generally there is no decidual reaction in these cases.

Ovarian pregnancy is difficult of diagnosis. Spiegelberg has laid down that the following four conditions must be fulfilled before ovarian pregnancy is diagnosed by examination of specimen :—

- (i) The Fallopian tube on the affected side must be intact.
- (ii) The gestation sac must occupy the position of the ovary, and there should be no separate ovary on the affected side.
- (iii) It must be connected to the uterus by the ovarian ligament.
- (iv) A histological examination must reveal the presence of definite ovarian tissue in the wall of the sac.

Although rupture is by no means uncommon in this condition a greater proportion of cases of ovarian pregnancy reach full term than do cases of tubal gestation. Occasionally the fertilised ovum may die inside the follicle and a mole formed.

Primary Abdominal Pregnancy

This is one of the rarest forms of extra-uterine gestation. Theoretically it is possible and a few cases are reported in the literature. There is some doubt as to whether such cases are in reality cases of primary abdominal pregnancy or cases of secondary abdominal pregnancy. From a clinical point of view the differentiation is not important.

Tubal Pregnancy

Pregnancy may occur in any of the four situations already mentioned namely, in the interstitial, isthmal, ampullary or infundibular portions of the tube. Sometimes one may speak of a tubo-ovarian pregnancy where an infundibular gestation has become attached to the ovary.

Fertilisation normally takes place in the lumen of the Fallopian tube whence aided by the ciliated epithelium of the tube the fertilised ovum makes its way into the uterine cavity where it implants itself on the already prepared endometrium.

In cases of tubal gestation the passage of the fertilised ovum into the uterine cavity is delayed or obstructed by developmental, mechanical or other factors. These are usually congenital anomalies of the tube (unusually long and tortuous), subacute salpingitis favouring

destruction of the cilia of the tubal epithelium and pressure from outside.

Mode of implantation of the ovum.

When the fertilised ovum is arrested in any portion of the tube, it burrows itself into the wall of the tube on account of the eroding and penetrating properties of the chorionic epithelium. There is no real decidual formation or decidual reaction in the stroma of the tubal mucosa; there is, however, increased congestion and softening of the parts. The ovum, after burrowing rapidly into the softened and highly vascularised tissues, forms a capsule of the muscular tissue of the tubal wall. Because of the absence of decidual formation the destructive action of the trophoblast is not controlled and thereby the muscular wall of the tube and blood vessels become eroded. As the ovum grows the muscular tissue attempts to hypertrophy. But there is only hyperplasia of the muscle cells and no hypertrophy and so the tube is not able to accommodate the growing ovum. The thinning of the Fallopian tube on account of the trophoblastic infiltration, uncontrolled by decidual cells, and the mechanical distension of the lumen of the tube by the growth of the ovum, results in early rupture of the tube.

Changes in the Uterus.

Simultaneously with the changes in the tube, the uterus in the majority of cases enlarges, but not to the same extent as in a uterine gestation. There is a decidual reaction of the endometrium, which accordingly becomes thick and spongy and is similar to that of the decidua vera in a uterine pregnancy. It does not, however, contain any chorionic elements and is generally passed out of the uterus in whole or piecemeal at the time when the tubal gestation terminates either by rupture or by abortion. This constitutes the decidual cast.

Terminations of Tubal Gestation.

The possible terminations vary with the site of the gestation.

A. Interstitial Pregnancy.

Here the fertilised ovum is implanted in the interstitial portion of the tube, and it is possible for it to progress for a much longer period than in the other regions. The period of its continuation depends upon the extent to which the implantation involves some portion of the uterine cavity. The terminations in this condition are :—

- (i) Abortion.
- (ii) Tubal rupture
- (iii) Tubo-uterine pregnancy.

Abortion. Owing to the situation of the ovum as it develops intratubal rupture most commonly takes place and the mass is ex-

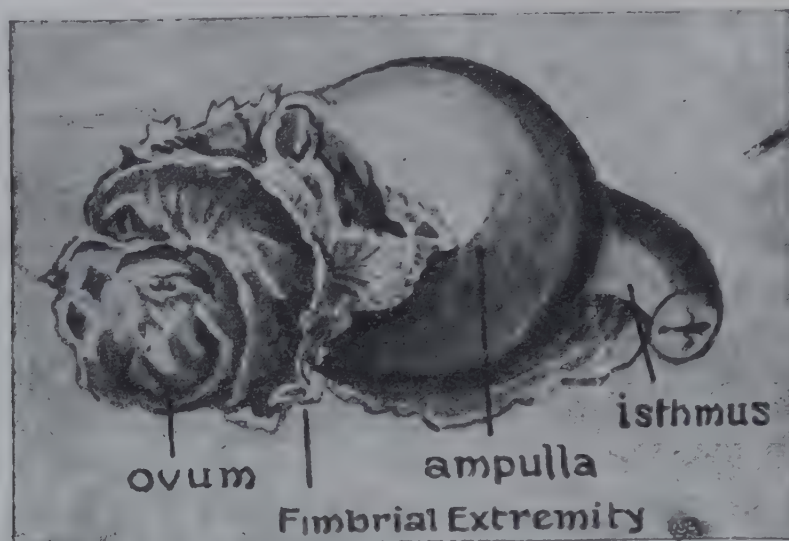


FIG. 72.—Tubal abortion.

truded towards the uterine cavity because of the dilatation of the uterine end of the Fallopian tube. If the ovum is entirely expelled into the uterine cavity, hæmorrhage is checked by contraction of the muscular fibres of the uterus and the mass thus expelled out may be mistaken for an ordinary uterine abortion.

Rupture. By distension or by erosion, rupture may occur towards the peritoneal cavity. The hæmorrhage here is fairly severe and death of the ovum generally takes place. In rare cases the rupture may not involve the placental site, and if the amniotic sac is preserved intact the ovum may continue to grow, resulting in secondary abdominal pregnancy.

Tubo-uterine pregnancy. In some cases the ovum as it grows may partially embed itself on the uterine wall and its further progress may be on the same lines as in a uterine pregnancy. It is difficult to differentiate this condition from a cornual or angular pregnancy.

B. Isthmial Pregnancy. Here the fertilised ovum implants itself in the narrowest portion of the tube. Consequently rupture, which is inevitable, occurs at a much earlier stage, generally before the twelfth week and usually between the sixth and tenth weeks or even earlier—sometimes even before the patient realises that she is pregnant.

The common modes of termination are :—

(1) Extra tubal or intraperitoneal rupture with severe intraperitoneal hæmorrhage resulting in death of the fertilised ovum and at

times of the mother if untreated. Occasionally the rupture may not involve the implantation site and the extruded foetus may continue to develop in the peritoneal cavity giving rise to a secondary abdominal pregnancy.

(2) The tubal rupture may take place into the layers of the broad ligament resulting in a broad ligament hæmatoma with or without the death of the fertilised ovum. If the foetus survives the rupture and continues to grow a secondary broad ligament pregnancy results. This may again rupture at a later stage resulting in secondary abdominal pregnancy.

C. Ampullary Pregnancy. Here the ovum is implanted in the outer third of the Fallopian tube. As the ovum grows, the ampullary portion becomes very much distended. The terminations that may occur in this condition are (i) tubal abortion, (ii) tubal mole formation and (iii) intraperitoneal rupture.

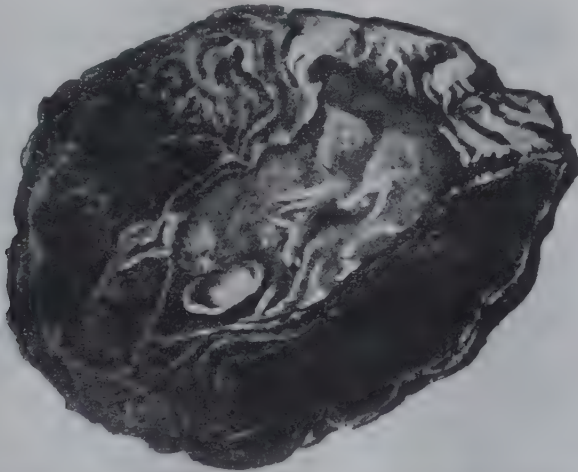


FIG. 73.—Mole formation in tubal gestations. Note the presence of the embryo.

Tubal abortion is by far the commonest termination. Intratubal rupture first occurs and the whole mass may then be expelled through

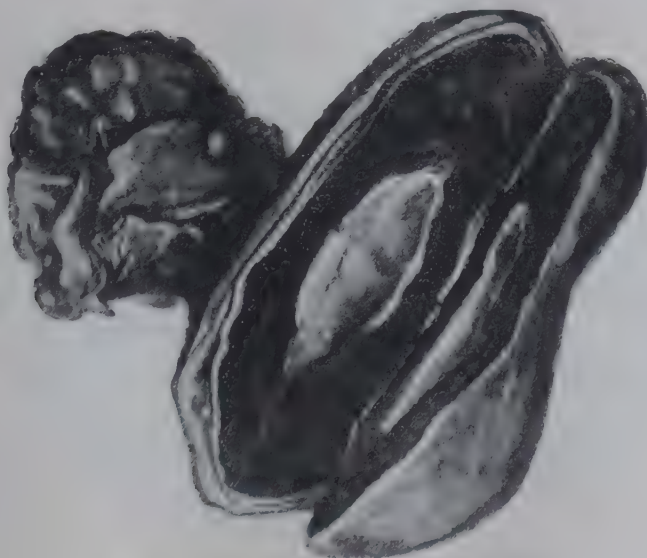


FIG. 74.—Section of a tubal mole. Note the clear amniotic cavity.

the dilated fimbriated extremity. The mass thus expelled consisting of ovum and blood forms a pelvic hæmatocele. The abortion may be complete, when the bleeding stops and the patient is left with a collection of blood and clots along with the dead ovum constituting a pelvic hæmatocele. If small, the hæmatocele may get absorbed and a cure may result. On the other hand the ovum may only be partially expelled as in an incomplete abortion and blood may then continue to leak through the open ampullary end of the tube giving rise to dull aching pain, and formation of a pelvic hæmatocele which gradually increases in size as the slow bleeding continues. There may take place a rupture into the peritoneal cavity producing a picture of acute shock. In some cases the pelvic hæmatocele gets infected and results in a pelvic abscess.

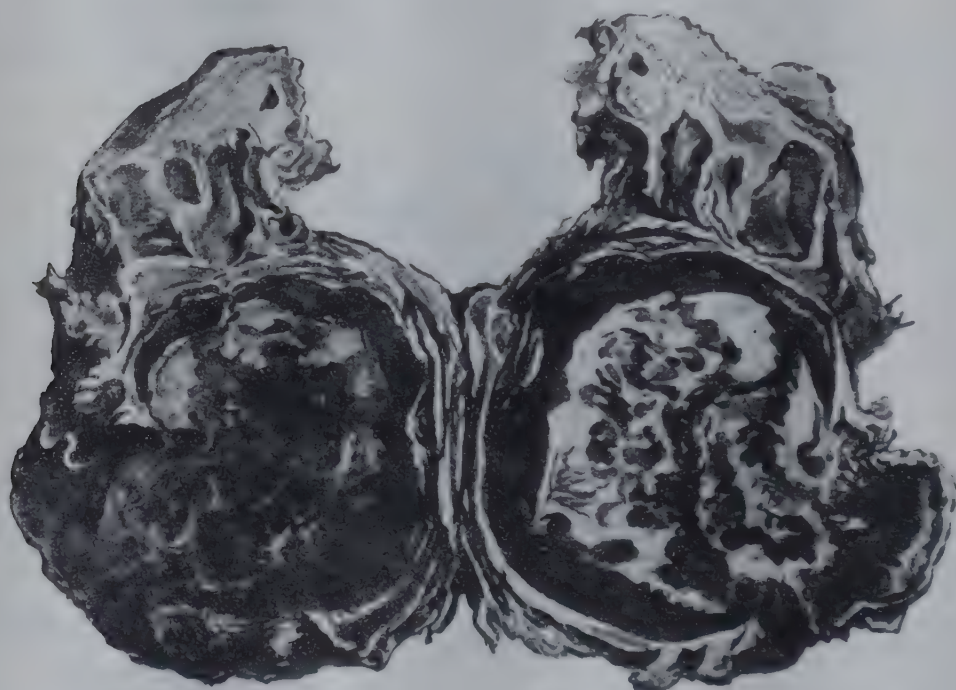


FIG. 75.—Section of a tubal mole.



FIG. 76.—Ruptured tubal gestation of about 20 weeks.
Note the hand and foot in the sac.

Tubal mole is also likely to occur. This results from an intratubal rupture. In such cases the blood clot surrounding the ovum becomes organised and results in the formation of a tubal mole in much the same manner in which a uterine mole develops.

D. Infundibular Pregnancy. This is merely one form of ampullary pregnancy where the ovum develops at the very end of the Fallopian tube near the fimbriated extremity. This is most likely to result in tubal abortion or it may develop into a tubo-abdominal pregnancy and progress till the later weeks of pregnancy.

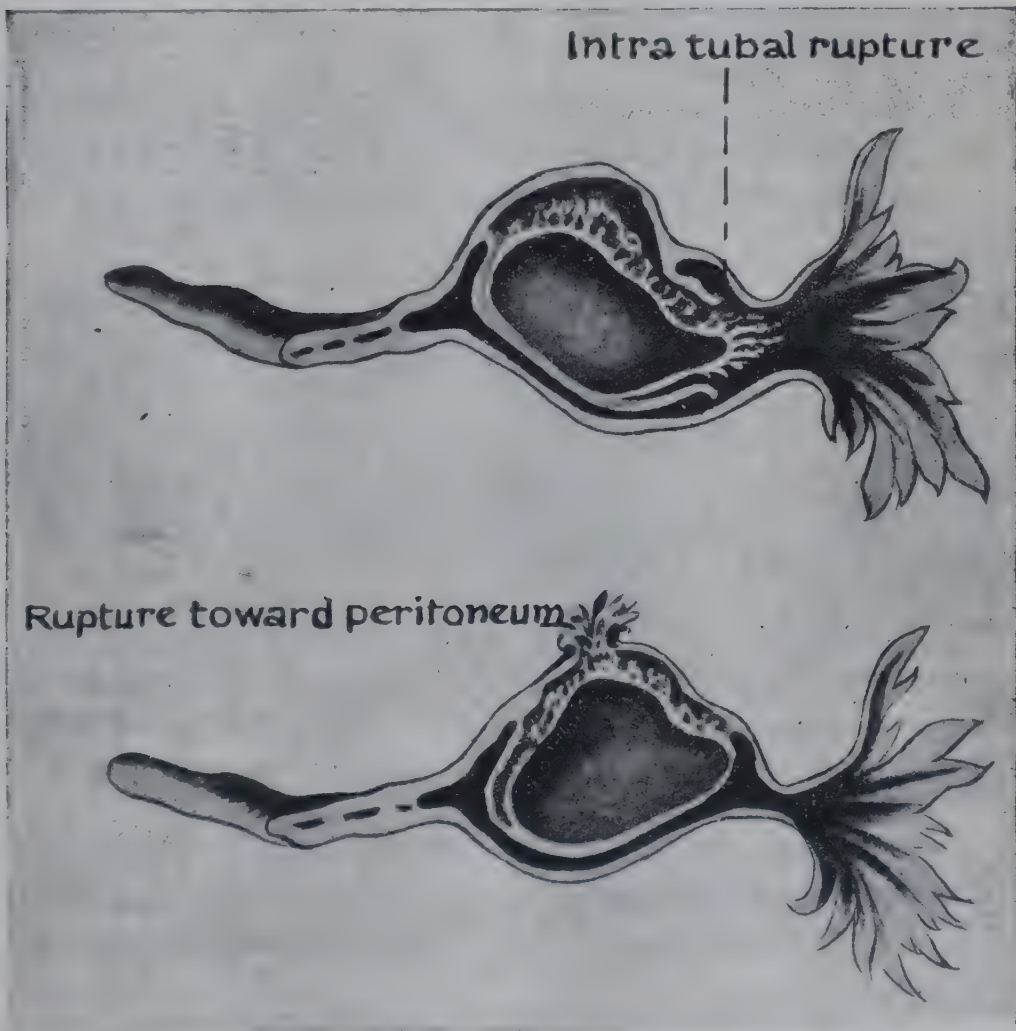


FIG. 77.—Rupture of an ectopic in the ampulla.

Signs and symptoms of tubal pregnancy

The signs and symptoms will depend very much upon the time at which the patient first comes under observation—Broadly speaking three periods can be recognised :—

- (1) Before rupture of an extrauterine gestation.
- (2) At the time of rupture or abortion.
 - (a) Acute.
 - (b) Subacute or chronic,

(1) Before rupture. The ideal time for the treatment of an ectopic gestation is before rupture. But unfortunately at this stage there are few signs and symptoms which are diagnostic. There is often a short period of amenorrhœa which may not be typical since at times there may be slight spotting of blood. Colicky pains in the lower abdomen giving rise to discomfort but not acute distress also may be present. The most important finding however is on pelvic examination. The uterus will be felt to be smaller than the period of amenorrhœa would warrant. Some degree of softening of the cervix may be present. In one or other of the fornices a tender unilateral pulsatile swelling separate from the uterus could be made out. Such a finding is very suggestive of ectopic gestation.

In an interstitial pregnancy the swelling is more or less continuous with the uterus, so that at one cornu of the uterus is asymmetrical in shape. In such cases the swelling may be easily mistaken for a cornual pregnancy.

The uterus may be pushed to one side or other, and in some cases may be displaced backwards or tilted anteriorly, depending upon the position of the mass. Occasionally a slight blood-stained discharge may be present on the examining finger. Pelvic examination should be very gentle. Cases have been reported where a somewhat rough examination has resulted in rupture taking place actually on the examination table.

(2) At the time of rupture—acute. The symptoms consequent on rupture or abortion differ in some important respects. When rupture takes place, the symptoms are of a more grave nature than in the case of tubal abortion. The chief signs and symptoms of rupture are those due to shock and hæmorrhage. The pain is so intense that the patient may faint. Associated with the pain is collapse due to intraperitoneal or subperitoneal hæmorrhage, which may at times prove fatal. The abdomen is tender, becomes distended and a certain amount of fullness may be felt in the flanks. A sign that may be present is shifting dullness; but this is not easily ascertainable, nor is it desirable to move the patient about to elicit this sign. A bimanual examination of the patient at this time may not reveal any definite signs beyond extreme tenderness in the fornices, especially if the rupture has taken place before the twelfth week of pregnancy. In cases of diffuse intraperitoneal hæmorrhage no fullness or resistance may be felt in the fornices. It is not easy, in view of the pain and the collapsed condition of the patient, to make a bimanual examination in any detail, nor is it advisable in such cases to attempt to do so. If the patient is seen a few hours after rupture and there has been time for the blood to coagulate, it is possible that a soft boggy tender swelling may be felt in one or other of the fornices or in Douglas' pouch. If a

broad ligament hæmatoma develops the signs and symptoms are less acute. The patient may recover sufficiently and after some days of

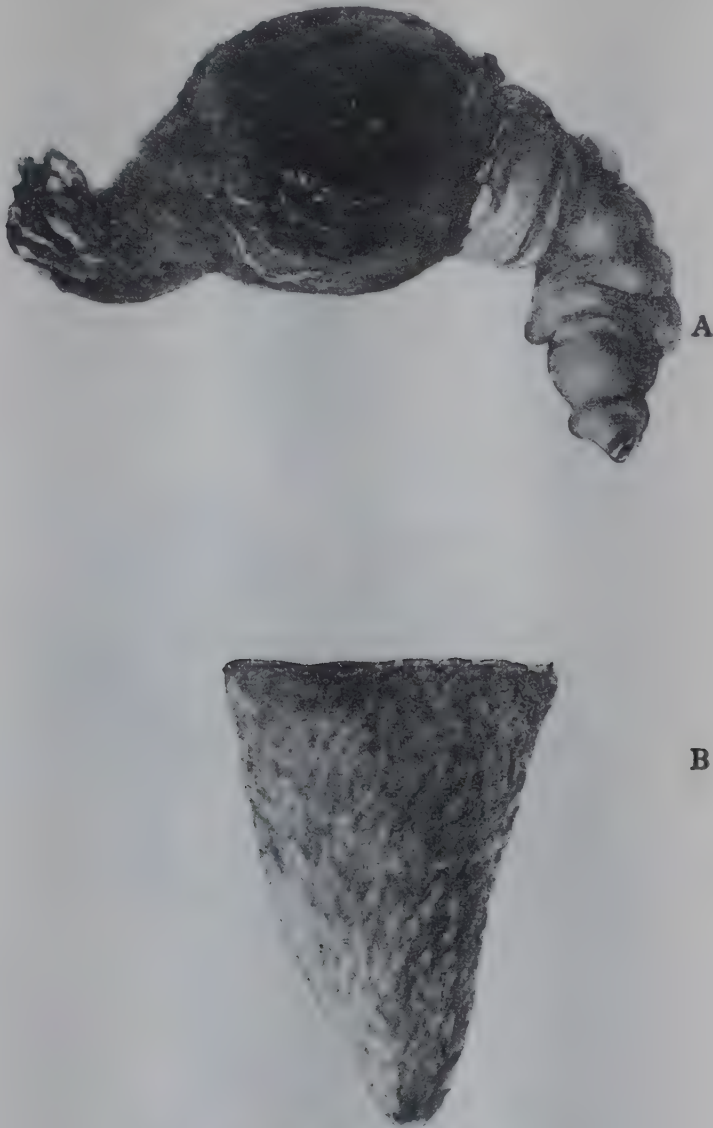


FIG. 78.—Ectopic gestation.

- A. Tubal abortion showing the ovum being extruded.
- B. Decidual cast expelled in the same case.

rest be able to carry on limited activity. Vaginal examination will reveal a uterus displaced to one side and tender swelling in one of the fornices. It may be palpable per abdomen.

Tubal abortion.

Tubal abortion is much more frequent than rupture and its symptoms and signs especially in the subacute or chronic varieties are at times indefinite and confusing. The pain is not of the same excruciating nature, but is more intermittent and prolonged. The extent of the hæmorrhage is less than in intraperitoneal rupture, so that the collapse following tubal abortion is not so severe as in cases of rupture. Along with the pain slight vaginal bleeding occurs occasionally followed by

expulsion of a decidual cast, either entire or piecemeal. The amount of external bleeding is relatively small and never proportionate to the degree of collapse and may continue for a few days. On the other hand,

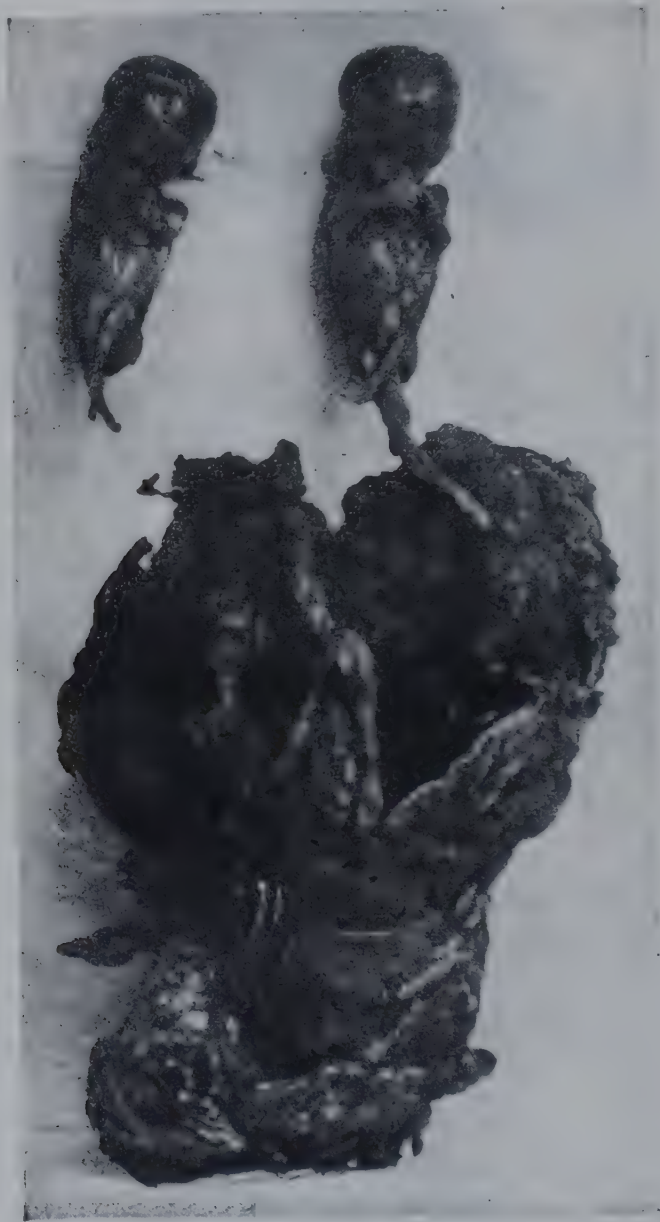


FIG 79.—Extra-uterine pregnancy showing twins.

in fulminant cases of intraperitoneal rupture, there may be no bleeding per vaginum. The passage of a decidual cast is pathognomonic of extra-uterine gestation. A complete decidual cast, which is a triangular shaped membranes, smooth in its interior and shaggy outside, with three openings corresponding to those of the two Fallopian tubes laterally and the internal os below, is rarely met with. It is much more frequent, however, in cases of tubal abortion than in rupture. The decidual cast is more often passed in bits mixed with blood. On microscopic examination no chorionic villi will be seen in such decidual casts.

In cases of tubal abortion a bimanual examination will reveal the presence of a very tender mass to one side of the uterus. This is a pelvic hæmatocele which forms generally in Douglas' pouch, and it may present more or less as a crescentic swelling extending from one lateral fornix to the other behind the uterus. The mass may in some cases be continuous with the tube of the affected side. The uterus is generally displaced by the hæmatocele and it may be pushed to one side or forwards.

Subacute or chronic cases. Patients usually give a history of a short period of amenorrhœa with occasional attacks of colicky, lower abdominal pain associated at times with slight vaginal bleeding. With rest in bed the pain and bleeding tend to stop only to restart after a few days of activity. The attacks of pain and its relief on rest may continue for a time ultimately resulting in a constant dull aching pain in the lower abdomen, frequency of micturition, difficulty in passing urine and tenesmus. There is general malaise, occasional vomiting and a small rise in temperature. She also develops a hypochromic anæmia. Occasionally the hæmatocele may rupture into the peritoneal cavity producing a picture of acute shock. A vaginal examination will reveal the presence of a tender, soft swelling filling the pouch of Douglas and extending to the lateral fornices. This is a pelvic hæmatocele. The swelling pits on pressure, is painful and tender. The mass may be palpable per abdomen.

Diagnosis. Early diagnosis in tubal pregnancy is most important. In fact it is failure to make the correct diagnosis promptly that accounts for almost all deaths in this condition. Unfortunately there are so many pitfalls in its diagnosis. The errors in diagnosis may be as high as 20-25%.

Before rupture. This may prove difficult. A unilateral tender adnexal swelling in a woman with early amenorrhœa should always lead to the suspicion of an ectopic gestation. There is thus a need for a vaginal examination in early pregnancy. It can however be often confused with an inflammatory mass (which is often bilateral) an ovarian tumour or even a pedunculated fibroid. In all doubtful cases it is advisable to do a laparotomy.

(a) **At the time of rupture or abortion—acute cases.** The picture at this time is typical of an acute abdominal catastrophe—the patient being in a state of shock and collapse due to intraperitoneal hæmorrhage. In the differential diagnosis, acute torsion of an ovarian cyst, torsion or rupture of an abdominal viscus, rupture of a pyosalpinx, and occasionally rupture of a maturing graafian follicle or corpus luteum

of the ovary with profuse hæmorrhage have all to be considered. Therefore history of the illness becomes very important. Blood can be obtained in cases with intraperitoneal hæmorrhage if the Douglas' pouch is aspirated through the posterior fornix. In any case such an acute condition always indicates immediate laparotomy when the diagnosis will be obvious.

(b) Subacute or chronic cases. These cases also give rise to difficulty in diagnosis. A history of amenorrhœa with attacks of colicky pain and vaginal bleeding may suggest threatened abortion with or without a retroverted gravid uterus. In threatened abortion the pain is milder than in an ectopic. The size of the uterus corresponds to the period of amenorrhœa while in ectopic gestation it may be smaller. There are no adnexal swellings in the former while a very tender boggy swelling extending from one fornix and posteriorly can be made out in the latter. Sometimes if the gravid uterus is retroverted it may be difficult to differentiate it from the pelvic mass separately. The extreme tenderness on palpation is very characteristic of an ectopic gestation.

Inflammatory adnexal swellings and ovarian tumours also have to be differentiated. A history of a short period of amenorrhœa—typical or atypical—followed by colicky pains, slight vaginal bleeding would be more in favour of ectopic gestation. Confirmatory evidence can be had by aspiration of the Douglas' pouch when old blood with small clots can be obtained in cases of ectopic gestation. Occasionally the pregnancy test may be of some help.

Prognosis. With modern methods of treatment the prognosis from this once dangerous complication has remarkably improved. It is rare nowadays to lose a patient from an ectopic gestation.

Treatment. The usual treatment of tubal pregnancy is immediate laparotomy and salpingectomy. The unaffected tube need not be removed if it is healthy. The ovary on the affected side if not diseased may be conserved. If the patient is in shock simultaneous blood transfusion is a necessity. The response of most patients to the operation is dramatic. When fresh blood is not available, in the event of an emergency and not as a routine transfusion of blood collected in the abdomen is advocated.

Rarely a hæmatosalpinx may be found on the unaffected side. The pathogenesis of this condition is not clear. Where child-bearing function has to be preserved this tube need not be removed.

Where a diagnosis of pelvic abscess has been made the treatment

is to drain it by posterior colpotomy and control of infection by administration of suitable antibiotics.

Abdominal pregnancy. Primary implantation of the ovum on the peritoneum is extremely rare. Almost all cases are therefore secondary to early rupture of a tubal pregnancy into the peritoneal cavity. Secondary abdominal pregnancy may also result from rupture of an intra ligamentous pregnancy. Occasionally it may result from the silent dehiscence of a classical cæsarean section scar. In most cases the trophoblast after rupture maintains its tubal attachment and gradually encroaches on the neighbouring peritoneum. The foetus usually but not always surrounded by amnion continues to grow within the peritoneal cavity. In such circumstances the placenta is found in the region of the tube and over the posterior aspect of the uterus and broad ligament.

Signs and symptoms. Since early rupture of a tubal pregnancy is the usual cause, a history suggestive of the accident can be obtained in many cases. Thus a history of irregular bleeding or pain following a short period of amenorrhœa can be elicited in the great majority of cases. Gestation is likely to be uncomfortable—nausea, vomiting, constipation or diarrhœa, abdominal pain and sometimes slight rise in temperature and mild jaundice may each be found in varying degrees. Late in pregnancy foetal movements can be felt with great ease and be painful.

Perinatal mortality in secondary abdominal pregnancy is in the region of 95%. Some authors report a high incidence of congenital abnormalities in the foetus. If the foetus dies after reaching a size too large to be absorbed, it may undergo suppuration, calcification, mummification or adipocere formation. When the gestation sac is adherent to the intestines pyogenic bacteria may gain access to it and cause suppuration of its contents (i.e. the suppurating gestation sac). Eventually the abscess ruptures and if the patient does not die from septicæmia foetal parts may be extruded through the abdominal wall or more commonly through the bladder or rectum. In some gestation may go on to term when a spurious labour ensues and the foetus dies. The liquor gets absorbed and the abdominal enlargement decreases. Mummification and formation of a lithopædian occasionally ensue and the calcified products of conception may be carried for years without producing symptoms.

Diagnosis. The history often gives the first clue in these cases. On abdominal examination the abnormal position of the foetus often transverse is frequently met with. The foetal parts are very easily palpable though this may be so in normal uterine pregnancy especially in grand multiparæ. Foetal heart sounds if heard are unusually loud.

Braxton's contractions are absent. On vaginal examination the cervix is usually displaced depending in part on the position of the fœtus and the presenting part is unusually high. The uterus may be made out separately occasionally.

X-ray examination often reveals the fœtus in a transverse or oblique lie and in an unusual attitude and location. A lateral view shows fœtal parts overlying the maternal vertebræ. Hysterogram will clinch the diagnosis as the fœtus will be demonstrable outside the uterine cavity.

The oxytocin test is a valuable aid in the diagnosis of abdominal pregnancy. One unit of oxytocin is given intramuscularly while the abdominal mass is carefully palpated. Contractions can be felt within three to five minutes with an intra uterine pregnancy.

Treatment. The operation for removal of an abdominal pregnancy is often associated with severe hæmorrhage. Hence without enough blood being available it would be unwise to resort to it. The massive hæmorrhage resulting from the operation is due to separation of the placenta during operation. It has therefore been suggested that operation be postponed till the fœtus is dead in anticipation of diminished vascularity resulting therefrom. But delay may sometimes be disastrous as spontaneous separation of the placenta may occur while waiting. The consensus is that it is better to operate as soon as diagnosis is made.

At laparotomy an important consideration is the management of the placenta. Since its removal is always associated with severe hæmorrhage, it should not be attempted unless it is possible to ligate all the blood vessels supplying the placenta. In those rare instances where the placenta can be easily removed without provoking hæmorrhage it may be removed. Else the best policy is to avoid unnecessary exploration, remove the infant, tie the cord close to the placenta and close the abdomen without drainage.

In the majority of cases the placenta is resorbed without giving rise to serious complication. In some, infection and suppuration may develop with discharge of pus through the abdominal incision. Such abscess may also point in the cul de sac or in the inguinal region when they should be drained.

When the woman comes with signs of infection.

Where the gravid sac is infected, the risks are grave. It is better to attempt to control the infection by intensive antibiotic therapy and operate and remove the mass after it is controlled. At times even in

spite of antibiotics the infection persists in which case one has to take the chance, and do a laparotomy to remove the infected sac. When foetal bones are being passed per rectum, as happens at times, laparotomy is indicated to remove the remnants. The fistula will not close till all bones are removed.

Prognosis. As stated before perinatal loss is high as also the maternal mortality.

Pregnancy in a Uterine Horn. One type of uterine malformation is where a small vestigial sac is present which sometimes communicates with the main cavity. Occasionally the fertilised ovum migrates into this sac and develops there and causes the same difficulties as are met with in cases of tubal gestation. The development of the ovum in the rudimentary horn is associated with the formation of a false decidua in the uterine cavity proper. The uterus increases in size. As the muscular tissue of the rudimentary horn is poorly developed and cannot keep pace with the progressively enlarging ovum, rupture takes place. This may occur at any time within the first sixteen weeks of pregnancy. At times however the pregnancy may go to near term.

It is difficult to diagnose this condition with any degree of certainty. When a pulsating mass corresponding in size to the duration of pregnancy is detected alongside the slightly enlarged uterus, suspicion may be roused as to the possibility of pregnancy in a rudimentary horn. Before operation it is almost impossible to differentiate it from the more common tubal gestation. The round ligament is external to the gestation sac when the pregnancy is in a rudimentary horn, while in tubal gestation it is on the mesial side.

Treatment. The only thing to do is to remove the pregnant horn of the uterus, conserving the main body of the uterus if possible. It may be necessary to perform a hysterectomy at times.

Repeated extra-uterine pregnancies. Not infrequently a woman who has had an extra-uterine pregnancy once on one side may have an extra-uterine on the other side. Such cases are on record and are within our own experience. In one case the patient had three consecutive extra-uterine pregnancies, one on each side and the third in the stump of a tube remaining after a previous partial salpingectomy which had been performed for an extra-uterine gestation.

Combined extra-uterine and intra-uterine pregnancies. A tubal gestation is sometimes associated with an intra-uterine pregnancy. Such cases are rare, but are attended with considerable risks.

Twins and triplets have been met with in an extra-uterine sac.

The concurrence of a vesicular mole in an extra-uterine gestation is exceedingly rare, but has been noted. The danger in such a case is obvious.

ANTEPARTUM HÆMORRHAGE

ANTEPARTUM hæmorrhage is defined as bleeding from the genital tract after the twenty-eighth week of pregnancy and before delivery. There are several causes. A pregnant woman may bleed from causes, which may give rise to hæmorrhage in a non-gravid woman, such as cancer of the cervix, a fibroid or a mucous polypus of the cervix, erosion of the cervix, cervical varices, ulceration of the vagina or from trauma. Apart from these coincidental factors, the main causes of the bleeding are :—

- (1) Premature separation of the placenta or abruptio placentæ
- (2) Placenta prævia.
- (3) Rupture of the marginal sinus.
- (4) Circumvallate placenta.
- (5) Vasa prævia.
- (6) Unclassified.

The placenta is in the large majority of cases situated in the upper uterine segment or zone of contraction, usually near the fundus on the posterior wall of the uterus and less frequently on the anterior wall. The placenta may in some cases be situated wholly or partially in the lower uterine segment or zone of dilatation. When hæmorrhage occurs as a result of the separation of a normally situated placenta—it is spoken of as accidental hæmorrhage or abruptio placenta. A placenta situated wholly or partially in the lower uterine segment is termed placenta prævia and hæmorrhage from it is termed unavoidable hæmorrhage. Owing to the situation of the placenta its separation and consequent hæmorrhage are inevitable when the lower uterine segment dilates during pregnancy and labour.

Abruptio Placenta

Incidence. The incidence of premature separation varies greatly from clinic to clinic. During a four year period among 55,934 deliveries there were 1,553 cases of antepartum hæmorrhage, an incidence of 1 in 36.

<i>Total No. of deliveries</i>	<i>No. of Cases of A.P.H.</i>	<i>No. of Cases</i>		
		<i>No. of Cases of Acc. hge.</i>	<i>of Placenta prævia</i>	<i>Unclassified</i>
55,934	1553	1081	296	176
Incidence	1 in 36	1 in 52	1 in 187	1 in 315

The incidence of premature separation was 1 in 52 which demonstrates that it is the commonest cause of antepartum hæmorrhage.

Ætiology. Accidents play a very minor rôle in its causation. Ever since Chantreuil first noted its association with albuminuria, more and more emphasis has been laid on pre-eclamptic toxæmia, essential hypertension and chronic nephritis as prime ætiological factors. The incidence of toxæmia in accidental hæmorrhage has been reported to range from 35%-91.3%. A careful analysis of the 1081 cases has shown that in our series, the incidence of toxæmia, hypertension or chronic nephritis has been 21.2%. We believe that accidental hæmorrhage is of two types—a toxæmic variety and a non-toxæmic variety. In our opinion the non-toxæmic variety of accidental hæmorrhage is more common, and when present, can be equally severe in its clinical manifestations and grave in its prognosis as the toxæmic accidental hæmorrhage. Too much stress has been laid for long on toxæmia as being the most important cause of accidental hæmorrhage. We have to look to other factors also. It has been our experience that it is very uncommon to see eclampsia and accidental hæmorrhage in the same patient. In 1150 cases of eclampsia there were only 10 cases of accidental hæmorrhage.

Endometritis, arteriosclerosis, syphilitic infection may all produce changes in the placenta as well as in the endometrium leading to a premature separation of the placenta.

The table below gives the incidence of conditions found in association with the 1081 cases.

<i>Associated conditions</i>	<i>No. of cases</i>
P.E.T., hypertension, chronic nephritis ...	230
Fibroid uterus ...	4
Trauma ...	3
Twins, hydramnios ...	14
Unknown ætiology ...	830
Total ...	1081

It has been suggested that accidental hæmorrhage is more common in those with Folic Acid deficiency and megaloblastic anæmia. Our investigations have shown that compared with the values obtained in normal pregnancy, there was no increased incidence of folic acid deficiency in patients who developed accidental hæmorrhage, nor was

accidental hæmorrhage more common in those with megaloblastic anæmia. In fact, the incidence of accidental hæmorrhage in 400 cases of anæmia (Hb level below 8.7 g. per cent) was only 0.75 per cent, and among 249 patients with anæmia due to a mixed deficiency of iron and folic acid there was only one such case. Furthermore, in 110 patients with accidental hæmorrhage in whom the serum folic acid activity was determined by bioassay it was observed that there were only 4 cases with serum folic acid activity of less than 4 μ g/ml the range being 0.65-27 μ g/ml.

Premature separation is more common in multigravidæ: the ratio of primi to multi being 1 : 9.7 while during the same period the general incidence of primi to multi was 1 : 3. Fifty per cent of patients had more than five pregnancies.

Duration of Pregnancy and Onset of Hæmorrhage. Premature separation may occur any time in pregnancy or labour. It is rather difficult to ascertain correctly the incidence of abruption in labour as the pain of premature separation may be confused with labour pains. In 68.4% abruption occurred antepartum. The time of occurrence of abruption is important in assessing prognosis. In 66% premature separation occurred prior to 36th week.

Varieties. Three types are usually described according to clinical findings. This may be based either on the nature of bleeding or on the condition of the patient—the latter classification is known after Page. The varieties are :—

(1) Revealed—In this condition the bleeding is completely external.

(2) Concealed—When the blood is retained inside the uterine cavity and not visible externally.

(3) Mixed—In this type the bleeding is revealed as well as concealed, part being retained inside the uterine cavity.

Page classifies premature separation as follows :—

Grade O : Clinically unrecognised before delivery and diagnosis is based on examination of the placenta.

Grade I : These show external bleeding only or mild uterine tetany but no evidence of maternal shock.

Grade II : In this group there is uterine tetany ordinarily with uterine tenderness, possibly with external bleeding, fetal distress or death but with no evidence of maternal shock.

Grade III: There is maternal shock or coagulation defects, with uterine tetany and intra-uterine death of the fœtus.



FIG. 80.—Abruptio Placentæ.
Note the hæmorrhage into the amniotic cavity.

In general it may be stated that almost all cases of revealed accidental hæmorrhage fall into Grade I, concealed hæmorrhage in Grade III, while the mixed type may fall into Grade II or Grade III depending upon the absence or presence of shock.

When the bleeding is entirely concealed, the blood may collect in any one of the following situations :—

- (1) Behind the placenta as a large retroplacental clot.
- (2) Between the membranes and the uterine wall separating the placenta and the membranes from the uterine wall.
- (3) In the amniotic cavity the blood finding its way into it by a tear through the membranes.
- (4) Behind a fixed presenting part (vertex).
- (5) The blood may occasionally extravasate into the uterine musculature. There may even be frank hæmorrhage into the peritoneal cavity and the broad ligament.

Whether the blood ultimately escapes outside or not depends upon the condition of the uterine musculature, its tonicity and power of contraction. If the normal tone of the uterine muscle is not impaired, it will contract when the blood escapes from the placental sinuses and thereby force it outside. In some cases the blood may from the very start find its way out alongside the membranes and through a partially dilated cervical canal. Where the uterine musculature itself is extensively disorganised by hæmorrhage its tone is completely lost, so that the blood collects within the uterine cavity and may distend it enormously. A fatal intra-uterine hæmorrhage may occur without any escape of blood externally. The mildest cases, which are the most common, are the revealed variety of hæmorrhages; in the moderately severe case the hæmorrhage first tends to collect inside the uterine cavity; but as the tonus of the uterine musculature does not allow the uterus to be distended beyond a certain limit, contractions of the uterus are provoked and the hæmorrhage at a later stage becomes revealed. These are the cases grouped in the mixed variety of accidental hæmorrhage.

In the concealed variety there are associated changes in the uterine wall. The muscle especially in the region of placental attachment is infiltrated by extravasated blood which ploughs up the muscle fibres tearing and injuring badly the tissues. The extravasated blood may be visible as bluish echymosis scattered throughout the uterine musculature and later becoming coppery brown. Occasionally longitudinal fissures are seen running over the uterine surface. In the broad ligaments, hæmatomas are not uncommon; the tubes and ovaries drip blood, and in some, free blood is present in the peritoneal cavity. Shock is the most predominant symptom in these cases. Because of the disorganisation of the uterine musculature, the uterus loses its contractile power and tone and distends easily with blood. To this hæmorrhagic infiltration of the wall of the uterus, Couvelaire in 1911 gave the name Utero-Placental Apoplexy. Intimately associated with this, is a bleeding tendency on the part of the patient. There seems to be, in some of the severe cases, a failure of the blood to clot due to lack of fibrinogen. These are the cases which are likely to be fatal. It is stated that these severe cases are commonly seen in association with hypertension and pre-eclamptic toxæmia. In our experience such cases are seen in the non-toxæmic varieties also.

Clinical Features. The clinical picture depends upon the degree of separation and type of bleeding.

The Mild Types. In this group of cases there is external vaginal bleeding associated with mild pains. The patients do not exhibit any signs of shock, the uterus on palpation is of normal tone, and the foetal heart is usually unaffected. These patients may get into labour

and deliver spontaneously of live children. If they do not go into labour, the bleeding may stop. Further separation, bleeding and pain may again occur later or they may without causing further trouble deliver spontaneously at a later date. Examination of the placenta after delivery shows dark adherent clots which on removal reveal depressed areas over the placenta.

The Moderately Severe Types. Here the patient may be seized with a sudden attack of pain at first localised and which later begins to spread over the uterus. Vaginal bleeding then commences. The foetal movements may no longer be felt. Examination reveals the patient in distress, pulse rate is increased and signs of shock of varying degree may be present. If the separation has been sufficient enough to produce intra-uterine death of the foetus, shock is often present. Palpation shows a uterus which is rather tense and tender. Tenderness may be localised or spread over the uterus which feels hard. Palpation of the foetal parts is rendered difficult and the foetal heart sounds are often absent. These are the cases usually associated with mixed variety of accidental hæmorrhage.

The Very Severe and Fulminant Types. The clinical picture is characteristic. The patient is seized with a sudden attack of acute pain over the abdomen and soon goes into shock and collapse. Vaginal bleeding may or may not be present. Pulse is rapid with blood pressure at shock levels—below 80 mm. of Hg. systolic. Patients with hypertension even if the systolic pressure is over 80 mm. of Hg., could be in a state of shock as prior to abruption the blood pressure would have been relatively at much higher levels. The uterus is distended with blood and may be larger in size than the period of amenorrhœa would indicate. In many cases it is of hard ligneous consistency, and in some, where the blood is still fluid, it is tense and a fluid thrill may be obtained. The uterus is so tender that patients resist even gentle touch. At times however tenderness is absent in some of the very severe cases probably because of the intensity of shock rendering the patient rather insensitive. The foetal parts cannot be palpated and the foetal heart is not audible as the foetus is invariably dead in these cases.

Diagnosis. Sudden onset of acute abdominal pain with or without vaginal bleeding and associated with signs and symptoms of shock, uterine tenderness on palpation absence of foetal heart sounds and increasing anæmia would indicate a severe type of accidental hæmorrhage.

It has to be differentiated from :—

(A) Placenta prævia.

(B) Acute hydramnios.

- (C) Tonic contraction of the uterus.
- (D) Rupture of the uterus—especially incomplete.
- (E) Other acute abdominal conditions.

The following are the points of differential diagnosis :—

In placenta prævia the hæmorrhage though sudden in onset is painless. It ceases only to recur at a later date as the pregnancy advances. The uterus is soft, there is no fœtal distress and the general condition of the patient unlike that in the severe varieties of accidental hæmorrhage is consistent with the amount of blood lost externally. If a vaginal examination is done the placenta could be palpated.

In acute hydramnios the sudden distension of the abdomen may give rise to increased pulse rate and mild degree of shock and unless the patient is already anæmic usually there is no pallor as is seen in accidental hæmorrhage. The uterus is very tense but not tender as in accidental hæmorrhage and in both neither are the fœtal parts easily palpable nor the fœtal heart sounds heard. If the os is open vaginal examination will reveal a very tense bag of membranes in hydramnios.

It is difficult at times to distinguish accidental hæmorrhage especially if it occurs in labour from an incomplete rupture of the uterus. In the latter condition there is always a history of prolonged obstructed labour, the uterus is tonically contracted and tender, with a stretched lower uterine segment, the fœtal heart may be absent or faintly heard. Vaginal examination usually reveals a presenting part jammed in cavity with a large caput.

Sometimes rupture of an abdominal viscus, or torsion of an ovarian cyst or other acute intra-abdominal conditions occurring during pregnancy may give rise to signs and symptoms of hæmorrhage and shock similar to those of *abruptio placentæ*. But a careful examination of the patient with the detailed history will generally enable the obstetrician to make the diagnosis without much difficulty. Occasionally, an exploratory laparotomy may be the safest method, where the diagnosis is uncertain.

The Prognosis. It depends on the severity. In the mild types with prompt treatment the risks to the mother are negligible while risks to the fœtus are enhanced. In the severe types the prognosis is definitely bad for the fœtus and grave for the mothers.

In over 60% the separation occurs when the fœtus is premature and hence, even if the baby is born alive, death in the neonatal period due to prematurity cannot always be avoided. Major degrees of abruption kill the fœtus almost always and at times cæsarean section in the early phase of the separation may help to save the fœtus. The fœtal mortality in the severe cases is in the region of 70-100%.

As for the mother, the prognosis is rendered graver because of the serious complications encountered in these cases, namely :—

- (1) Shock.
- (2) Coagulation failure.
- (3) Renal failure.

It is necessary to know the factors which influence the onset of these complications in order to plan the proper line of management. Hence we propose to deal with this problem, prior to discussion of the treatment.

It was for a long time believed that the severe postpartum hæmorrhage which was found in association with severe cases of accidental hæmorrhage was due to atony of the uterus, the musculature of which has been disorganised by hæmorrhages into it, thus rendering it incapable of good retraction. The Couvelaire uterus was therefore made the indication for a hysterectomy. The studies of Weiner, Reid, Roby and many others have shown that in severe cases of accidental hæmorrhage there is a depletion of blood fibrinogen resulting in hypofibrinogenæmia or even in afibrinogenæmia (the so-called acute defibrination syndrome) attention to which had been drawn by Deickman years ago. This lack of fibrinogen results in incoagulable blood and hence severe bleeding. Schneider has explained the mechanism by which the blood is depleted of its fibrinogen. There are various factors concerned in blood coagulation. Two simple mechanisms are: (1) The entry of thromboplastin from the separated placenta and placental site into the maternal circulation through disrupted channels which initiates widespread intravascular clotting and thus depletes the body fibrinogen resulting in hypo or afibrinogenæmia. Once fibrinogen has reached a critically low level, uncontrollable hæmorrhage occurs not only from the uterus but also from the nose, mouth and any incisions or needle puncture sites. The increased intra-uterine pressure in *abruptio placentæ* is thought to be of prime importance in forcing thromboplastin into the circulation. (2) The production of fibrinolytics which dissolve any clot that is formed. The formation of fibrin in the vascular system activates the fibrinolytic system. Inert plasminogen is converted into plasmin by an activator. Plasmin has the property of lysing not only fibrin but also fibrinogen. As a result fibrinogen or fibrin degradation products are liberated into the circulation and these too have anti-coagulant properties. This understanding is very essential from the point of view of treatment and in the severe types of accidental hæmorrhage it is necessary that the obstetrician should be on the look-out for this complication.

It is extremely difficult to gauge the incidence of coagulation defects in accidental hæmorrhage. Firstly, because the urgency of the case demands immediate treatment; secondly, one cannot wait for the

blood fibrinogen level estimation results which take time ; and, thirdly, factors other than fibrinogen may be concerned in coagulation failure. From the clinical point of view the two useful bedside tests are (a) the clot observation test, and (b) Fibrindex test. The former takes time to read, while the latter is the quicker and more reliable.

The Clot Observation Test. 5 ml. of venous blood is collected in a dry test tube. Ordinarily a clot forms within 15-20 minutes and the clot retracts and remains firm at the end of an hour at 37°C. In some cases there is no clot formation and in the rest a clot may form but again begins to lyse or disintegrate on shaking. This infirm clot could be due to low fibrinogen level or the presence of fibrinolysins.

The Fibrindex Test. To 0.2 ml. of oxalated plasma 0.2 ml. of human thrombin solution containing 10 units (fibrindex) is added and the time for the formation of the clot is noted. If clot forms in 5 to 10 seconds and becomes firm in one minute it is suggestive of normal level of fibrinogen in the blood. If the level of fibrinogen is below the critical level for hæmostasis, a gel may be formed in 15 to 20 seconds instead of a clot. If no fibrinogen in blood is present, no clot formation occurs even in one minute. Varying incidences are reported ranging from 10 to 30 or 40%.

What factors influence the onset of coagulation failure ? There is reason to believe that the longer the detached placenta and blood are retained in the uterine cavity, the greater are the chances of coagulation defects occurring. In attempting to correlate the onset of abruption to the time of delivery it was observed that in a significant number where the uterus was emptied spontaneously or otherwise within eight hours of onset of abruption, the incidence of coagulation failure was minimal.

The treatment for these cases consists in combating the coagulation failure by sufficient fresh blood transfusion. Triple or quadruple strength plasma is very useful in replacing fibrinogen loss : fibrinogen if available can be used with great benefit (6 to 10 grammes). It is better not to make attempts at evacuation of the uterus by operative methods till the failure is corrected.

More recent studies seem to indicate that the problem of coagulation defect could be due to the activation of the fibrinolytic system as a result of fibrin formation. Once this system is activated to obtain homeostasis it is necessary to combat fibrinolysis. Hence it is advisable to test for the fibrinolytic activity of the maternal blood in all cases of severe accidental hæmorrhage.

If fibrinolysins are detected in the maternal blood the treatment consists in the administration of Epsilon amino caproic acid (EACA)

which is a synthetic amino acid which inhibits both plasminogen activation and formed plasmin. 5 to 15 g. can be given intravenously as a drip, over a period of 1-2 hours.

Trasylol is another drug which inhibits plasminogen activation and formed plasmin. This drug also has been recently employed, in combating hæmorrhage due to fibrinolysis; 25,000 units are given intravenously and if necessary 100,000 units in 500 ml. of saline in the next hour.

Renal Failure. Another of the dreaded complications of accidental hæmorrhage is renal failure. The mechanism of production is open to discussion but briefly oliguria and anuria in accidental hæmorrhage may be due to :

- (1) Shock—when systolic blood pressure falls below 80 mm. of Hg. glomerular filtration comes to a standstill.
- (2) Acute tubular nephrosis.
- (3) Cortical necrosis.

Oliguria or anuria due to shock usually responds to treatment directed towards combating shock. The mechanism of production of the other two conditions in accidental hæmorrhage is not well understood. The underlying pathology is a severe and prolonged spasm of the glomerular vessels which results in severe anoxia and death of the glomeruli. The spasm may be due to the action of some toxin liberated by the placental separation giving rise to cortical ischæmia, or cortical ischæmia may be the result of a uterorenal reflex evoked by the overdistension of the uterus with hæmorrhage which gives rise to a medullary shunt of the blood leaving the cortex anæmic. In those with hypertension the existing spasm may be exaggerated. Whatever be the reason, oliguria and anuria are dangerous complications.

The reported incidence of renal failure, in both oliguric and anuric cases, ranges from 5% to 35%. The higher percentage incidence includes cases of minor degrees of renal failure clinically evidenced as oliguria. In our experience the incidence including minor degrees has been in the region of 7%. It is mostly in the severe variety of abruption—Couvelaire uterus—that renal failure is met with. If it is considered that toxic absorption from placental abruption or distension of uterus with blood is a factor in the production of renal failure, it is possible that the time interval from onset of abruption to delivery may have some relationship to its production. It has been our experience that even in the severe varieties the incidence of anuria was negligible, if the uterus had been emptied spontaneously or otherwise within ten hours of abruption.

The Treatment of Renal Failure. Paravertebral block of the lumbar sympathetic ganglia T. 10, 11 and 12 at the onset of oliguria is said to be beneficial. If it is to be of any benefit, it should be done within 2-3 hours of the onset of renal failure. Intravenous administration of 20% mannitol solution is very useful. In established cases Bull's regime or modified lines as discussed previously under renal failure in obstetrics should be the line of management.

The Treatment of Premature Separation. *Mild cases.* Where pregnancy is premature and placental separation mild as in the mild type no active treatment need be adopted. The patient should be at rest in bed and carefully watched. Blood pressure, pulse and urinary output should be recorded. If the bleeding stops and the foetus is in good condition, pregnancy should be allowed to continue and active lines of treatment undertaken only when the bleeding recurs again after stopping. Artificial rupture of the membranes usually helps to control the bleeding and promotes labour. In most of the mild degrees premature separation results in spontaneous delivery with little risk to the mother and slightly higher foetal risk. It must be borne in mind that once premature separation starts, even a mild case may turn into a serious variety at any stage. Hence all cases require careful observation.

The Severe Cases. The principal lines of management of these cases are :

- (1) to combat shock and replace blood loss,
- (2) to relieve uterine distension,
- (3) to promote uterine contraction and hasten delivery, and
- (4) to watch for coagulation and renal failure.

Rarely is the foetus alive in these cases and only rarely is interference indicated for the sake of the foetus.

Management. We shall briefly indicate our methods of management in these cases. As soon as a patient is admitted with premature separation the first thing that is done is to take 10 ml. of venous blood for clot observation test, fibrinogen estimation and other investigations. A general and obstetric examination is then made. Special note is made of the uterus, its condition, whether tetany is present or not, tenderness and the foetal heart rate. The pulse and blood pressure are recorded to assess the degree of shock. An indwelling catheter is kept in the bladder and the drawn-out urine is examined for albumin, R.B.C.'s and casts. The blood set-up for clot observation is now looked into. If no solid clot has formed it is assumed that a coagulation defect has already developed. If a clot has formed it is checked up at the end of one hour when the presence of firm well retracted clot indicates normal clotting. If however the clot shows signs of lysis or fragmen-

tation on shaking, a coagulation defect is assumed. We depend upon this test and do it every hour in the severe types till the delivery is over and if necessary post-partum. The tubes are marked and taped to the wall near to the patient so that a record of clotting mechanism and response to treatment is readily available.

In all cases after the initial examination is over, the patient is given 100 mgs. of Pethidine, and compatible blood transfused. To determine the degree of shock and amount of blood to be transfused the ideal method would be to determine the central venous pressure (C.V.P.). Normally C.V.P. ranges from 3 to 10 cm. of water or 2 to 8 mm. of mercury. In cases of severe hæmorrhage the C.V.P. is low and enough blood should be transfused to bring it to normal levels. The determination of C.V.P. also prevents overloading with fluids as C.V.P. would rise above normal if overloading occurs. A vaginal examination is done to gauge the type of cervix, position and station of the presenting part, and in a primigravida to assess the pelvis also. Irrespective of any other factors the membranes are ruptured artificially below the presenting part to induce labour. An hour or two later, if labour has not commenced, an oxytocin drip is set up—2½ units in 500 cc. of 5% glucose to promote labour. Urinary output is recorded every hour; blood pressure and pulse are recorded every half hour. If, within 6-8 hours of induction, labour pains are not well established, or if progress is slow, or if in spite of sufficient blood transfusion the patient's condition is not improving or showing a tendency to deteriorate indicating continuance of the hæmorrhage, cæsarean section is done. If response to induction is favourable vaginal delivery is awaited. The second stage is cut short if necessary by outlet forceps. All clots are weighed after delivery and coagulation defects are looked for during post-partum period. If present, blood and plasma transfusions are given. Each case is individualised, assessed and treated on its own merits. The treatment employed in 1081 cases is shown below :—

	<i>No. of cases.</i>	
No treatment—spontaneous delivery		90
Artificial rupture of the membranes and vaginal delivery		210
A.R.M., Oxytocin drip and vaginal delivery		748
A.R.M. and Oxytocin drip followed by cæsarean section		25
Cæsarean section		5
Cæsarean hysterectomy		3
		<hr/> 1081 <hr/>
Vaginal delivery	1048	
Abdominal delivery	33	(Percentage 3.1)

Comment on A.R.M. (Artificial Rupture of the Membranes) and Oxytocin Drip. Controversy exists regarding A.R.M. in cases of purely concealed accidental hæmorrhage. One school believes that in such cases the patient should be treated for shock and hæmorrhage. After she rallies round and the uterus regains its tone as evinced by the bleeding becoming revealed, A.R.M. can be done and labour thus induced. In some cases cæsarean section may be done at this stage. It is argued that if A.R.M. is done when the uterus is over-distended and atonic, it will give rise to more internal hæmorrhage as the intra-uterine tension prior to A.R.M. helps to stabilise the hæmorrhage. There are others who believe that induction by A.R.M. and Oxytocin stimulation may result in precipitating coagulation failure in the severe cases as thromboplastin may be pumped into the maternal circulation by uterine contractions and hence they resort to cæsarean section.

These objections seem more theoretical. On the other hand relieving intra-uterine tension by A.R.M. as early as possible may help not only in hastening emptying of the uterus but also perhaps in preventing coagulation and renal failure. Hence we resort to routine A.R.M. in all cases and only in occasional instances resort to cæsarean section. Our incidence of cæsarean section for this complication is 3.1%. We have no reasons to believe that A.R.M. in such cases promotes more internal bleeding.

Induction Delivery Interval. One of the objections to induction by A.R.M. in the severe variety of cases is that labour may take a long time to start as in over 60% of cases the abruption has occurred in the antepartum period and the fœtus premature. It is also true that complications are more likely to occur if there is abnormal delay in emptying the uterus. With this in view we have analysed the induction delivery interval in cases which developed coagulation defects and/or renal failure and those that did not develop any complications. We could not find any significant difference in the average induction delivery interval in complicated and uncomplicated groups. In a large number response to A.R.M. and Oxytocin is not unduly delayed and is satisfactory but unfortunately complications have not been prevented. We believe the interval from onset of premature separation to delivery is the more important factor. In deciding the line of management it is essential that the interval between the onset of abruption and the start of treatment be taken into consideration. Even though response to induction may be satisfactory, if the bleeding had continued for long before start of treatment, it might not be satisfactory from the point of view of the ultimate result. Unfortunately, it has not been possible to decide, even with a fair degree of accuracy, what this optimum interval should be. In spite of the fact that most of these

hæmorrhages are in antepartum patients with a closed uneffaced cervix, it is surprising how a very large number of them respond satisfactorily to A.R.M. and Oxytocin drip in spite of the severity of the condition. This has been made evident by the average duration of the induction delivery interval.

Couvelaire Uterus. It is now assumed that in all cases of severe type of premature separation a Couvelaire uterus exists. Even so, vaginal delivery with frankly Couvelaire lesions is possible in the majority. Hence these lesions while suspected cannot be confirmed except at laparotomy. It is therefore difficult to give the exact incidence. Clinically a Couvelaire uterus should be suspected when

- (1) the separation is of a severe degree resulting in uterine tetany, shock and death of the fœtus ;
- (2) when there is no uterine response to induction after artificial rupture of the membranes and oxytocin drip ;
- (3) when the patient does not show improvement in her condition judged by blood pressure and pulse in spite of blood transfusion ;
- (4) when there is anuria ; and
- (5) when clotting defects are observed.

The Place for Cæsarean Section. It is difficult to state definitely the place for cæsarean section in premature separation, and opinions vary. There are many who resort primarily to cæsarean section. Others resort to A.R.M. and Oxytocin drip to help vaginal delivery and should it fail, perform cæsarean section. We adopt the latter procedure. Cæsarean section is indicated in the following instances :—

- (1) In cases of premature separation at or near term with a live fœtus, when the patient is not in labour or early in labour. In such cases the section is done to save the fœtus.
- (2) In the severe types, where 6-8 hours after artificial rupture of the membranes and oxytocin drip labour is not progressing satisfactorily, cæsarean section may be considered.
- (3) In cases where, after A.R.M., the patient does not show improvement in her general condition in spite of sufficient blood transfusion, thus indicating continuing hæmorrhage.

It is advisable to avoid laparotomy when coagulation defect is present. Only after correction of the defect should cæsarean section be performed.

At laparotomy in the majority of severe cases the uterus will be found Couvelaire. This should not be made the indication for hysterectomy. In most of these cases, the uterus will contract after removal of the contents. Post-partum hæmorrhage in these cases is mostly due to hypo or afibrinogenæmia. Hysterectomy is not the treatment for its cure. But at times, especially in a multigravida, atonic hæmorrhage may occur with Couvelaire lesions. Under such circumstances one will be forced to do a hysterectomy. While it is wise to avoid hysterectomy in these shocked patients it should not be avoided if indicated.

Post-partum Hæmorrhage and Accidental Hæmorrhage.

Severe post-partum hæmorrhage may follow vaginal delivery or Cæsarean section. Often it is due to coagulation failure when treatment should be directed towards its correction. At times the hæmorrhage may be due to uterine atony when treatment should be as for atonic post-partum hæmorrhage.

Causes of Maternal Mortality. The usual causes of death are :

- (1) Hæmorrhage due to coagulation failure, including post-partum hæmorrhage.
- (2) Renal failure. These may also occur in combination.
- (3) Shock.

In spite of great reduction in maternal and foetal mortality for placenta prævia at the present day, such significant reduction has not been obtained in cases of premature separation. While in the mild variety the maternal mortality is negligible, in other cases it is still 3%. The foetal mortality, varying according to the severity, ranges from 30%-80%. It would appear that there are many unknown ætiological factors and until these are elucidated premature separation will continue to be a serious obstetric problem.

The puerperium requires careful watching. Infections, embolism and thrombophlebitis are complications to be looked for. A prolonged convalescence is inevitable in all except the mild variety.

PLACENTA PRÆVIA

PLACENTA PRÆVIA is the condition where the placenta is situated wholly or partly in the zone of dilatation or lower uterine segment.

Ætiology and incidence

Placenta prævia may arise in different ways. Firstly, the ovum may become implanted by chance in the decidua close to the internal os, and thus the placenta must develop in the lower segment of the uterus; and, secondly, with implantation at the lowest point of the upper segment the chorionic villi may develop in relation to the decidua capsularis and so enable part of the placenta to gain attachment to the lower segment. It may be, too, that an unhealthy decidua predisposes to the placenta spreading over a larger area of the uterine wall in order to gain better nourishment for the fœtus; as a result the placenta may lie partly on the lower segment. This may explain why the placenta often has a large surface area than normal. It may also explain why the incidence increases with age. Twin pregnancy too, favours its occurrence owing to the larger area of placenta.

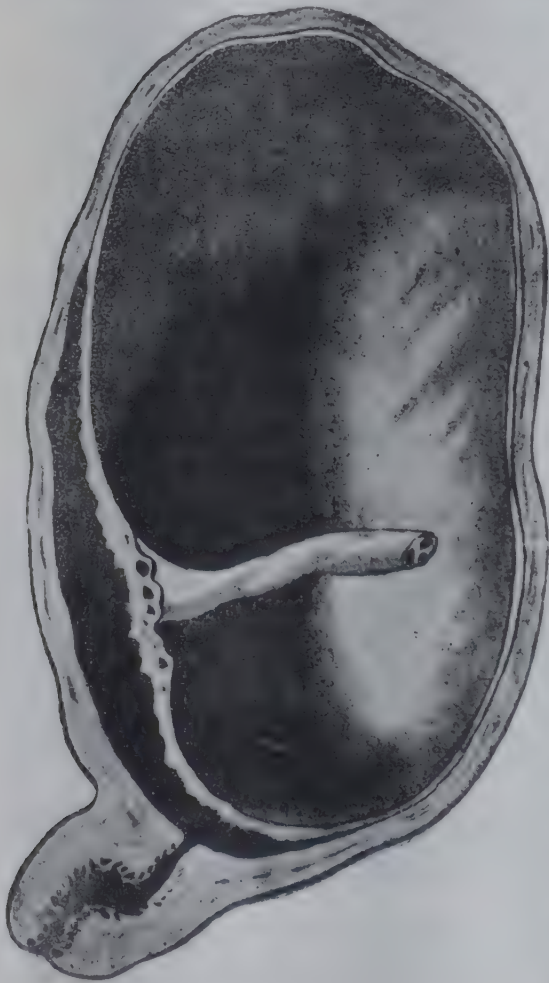


FIG. 81.—Partial placenta prævia.

Among 55,394 deliveries there were 296 cases of placenta prævia giving an incidence of 1 in 187.

Varieties. The extent to which the placenta is inserted into the lower uterine segment varies greatly, so that it is usual to classify this condition under three headings: (a) central, (b) marginal, and (c) lateral, according as the placenta covers the entire internal os, or reaches up to its margin, or merely dips into the lower uterine segment

and is just within reach of the examining finger. These degrees depend on the dilatation of the os, so that a case apparently of central placenta prævia at the onset of labour will become one of the marginal variety



FIG. 82.—Placenta prævia.
A. Marginal. B. Central.

when the cervix is two-fifths dilated. A more rational classification of the varieties of placenta prævia would be to divide them into total and partial varieties—the total variety being characterised by the placenta being almost wholly in the lower uterine segment and covering the undilated internal os by its central and thickest part. The partial varieties are those where the internal os is only partially covered by the placenta. The term 'low implantation of the placenta' is used when the lower uterine segment is encroached on by the placenta so that, on examination, the placenta edge can be palpated by a finger introduced through the cervical canal but the placenta does not extend beyond the margin of the internal os. F. J. Browne classifies placenta prævia into four degrees. Placenta prævia where the placenta dips into the lower uterine segment by its lower margin, the greater part of it being in the upper uterine segment, is described as first degree. When the edge of the placenta reaches the internal os, it is designated as second degree; when the placenta overlaps the internal os when closed but does not cover it entirely when fully dilated is described

It shows that in nearly 70% of cases the bleeding occurs when the foetus is less than 38 weeks old. There were in this series 119 cases of complete or central placenta prævia (types III and IV of Browne) and 177 of incomplete variety (types I and II) or lateral and marginal. The first bleeding took place during the 32nd week or earlier in 56 of the 119 cases (47.9%) of central placenta prævia, while during the same period among 177 cases of the incomplete variety bleeding took place only in 59 (33.3%) indicating that earlier bleeding is more likely to occur in complete varieties. However, it has been our experience that at times even in complete varieties the first bleeding has occurred only at about term.

The Posterior Placenta Prævia. The placenta may be situated in the lower uterine segment either anteriorly or posteriorly. In the incomplete varieties, where the placenta is situated posteriorly, it overlies the sacral promontory and because of its bulk reduces the space available at the brim for the head to come through. Hence, in these cases, the presenting part remains high and it will be found difficult to push the head through. This type of placenta prævia is, in addition, generally, associated with anomalies of the umbilical cord and hence cord compression and foetal death are very common.

The Diagnosis. A history of sudden painless bleeding which stops on its own to recur at a later date is very suggestive of placenta prævia.

Abdominal examination usually reveals a normal pregnancy with the foetus in most cases alive. If the patient is at term, the presenting part will be found much higher than usual in cases of major degrees of placenta prævia. At times a soft boggy feel over the lower uterine segment may be elicited. It will also be found difficult to push the head through the brim if a major degree of placenta prævia is present or if the placenta prævia is a posterior one. In the latter case, such attempts may be associated with irregularities of the foetal heart due to cord compression, as anomalies of the cord are found more commonly in association. The question of the increase of malpresentations and its relation to placenta prævia is debatable. Very often it is due to prematurity, and unless the placenta prævia is of a major degree, it is doubtful whether it can be the cause of malpresentation.

Vaginal examination will certainly help in diagnosis. But it should never be done just for the purpose of diagnosis as it is likely to provoke severe bleeding. It is indicated only when active steps to terminate pregnancy are considered and even then it is best done in the operation theatre where everything is ready for a cæsarean section, should the indication arise. On palpation in certain cases, through the vaginal fornices a soft boggy mass can be felt through which the

presenting part may be felt indistinctly indicating a major degree of placenta prævia. In the incomplete varieties the presenting part can be palpated clearly. When the cervix is dilated the placenta can be felt easily depending upon the degree. In cases of complete variety, the thick mass of placental tissue covering the internal os may be felt, whereas in the incomplete varieties it may be felt close to the margin of the cervix or high up by sweeping the finger round inside the cervical canal. Unlike a blood clot which is smooth and friable, the placenta is firm and tough and pits on pressure. Occasionally a cancerous growth of the cervix complicating pregnancy may be mistaken for placenta prævia.

Accessory Methods of Diagnosis. Among the accessory methods, radiology is the most important and useful. Various techniques have been employed to locate the placenta. These are discussed under 'Radiology in Obstetrics'.

Soft tissue radiography is a reliable method for localising the placenta. The appreciation of the hazards of radiation to the foetus has resulted in controversy regarding the use of such radiological procedures for diagnosing placenta prævia. To make a correct diagnosis two or three exposures may be necessary even in the hands of experts and it is for consideration whether the radiation hazards, even if it be very small, should be accepted for a diagnosis when clinically such diagnosis can be made with a very fair degree of accuracy. Routine placentography for diagnosis is not necessary but, when indicated in certain cases, it need not be withheld. The more recent developments in the diagnosis of placenta prævia has been the use of Sonar (ultrasonic echo sounding). Here the actual placenta can be visualised in two dimensions with considerable clarity and the risks from radiation are far less than from placentography.

Differential Diagnosis. Placenta prævia has to be differentiated from abruptio placenta. This has already been discussed under 'Accidental hæmorrhage'. The bleeding that occurs from cancer of the cervix and other cervical lesions with pregnancy may be mistaken for placenta prævia. Speculum examination and vaginal palpation usually help to confirm the diagnosis. Biopsy should always be done if malignancy is suspected.

Complications. The greatest danger is hæmorrhage. Apart from that, it is associated with premature labour, malpresentation, prolapse of the cord, adherent placenta and post-partum hæmorrhage. In the puerperium, infection and sub-involution may occur.

Prognosis. This depends upon various factors particularly the facilities available for treatment, the type of management adopted and

the time at which the patient is seen. The availability of blood transfusions, antibiotics and the extended use of conservative management and cæsarean section have improved considerably the maternal and foetal prognosis. The maternal mortality which was 11% twenty five years ago has now been reduced to less than 2%, so also the foetal mortality from 60% to 30%. Seventy per cent of the foetal mortality is due to prematurity. With better co-operation from patients and better pædiatric care it could be reduced further.

The Modern Treatment. It is based on the understanding that (1) in most cases the bleeding starts when the foetus is premature, (2) the first bleeding often stops on its own to recur at a later date and (3) the first bleeding is seldom severe enough to seriously affect the mother or child and so pregnancy need not be terminated at once when bleeding occurs. Also all such patients should be treated only in well-equipped institutions. This will help to lessen foetal mortality without enhancing maternal risks. From this idea was born the expectant line of management of placenta prævia.

The expectant line of treatment. This line of management should be undertaken only in well-equipped institutions where all facilities exist for blood transfusion and immediate cæsarean section, should the latter be necessary. It has no place in domiciliary midwifery. The main principles on which the expectant line of treatment is based have already been discussed and it is essentially meant to get a mature foetus without endangering the life of the mother. If a patient is seen in her house with antepartum hæmorrhage, the attending doctor should give her $\frac{1}{4}$ gr. morphia or any sedative and make arrangements to transport her to a hospital. In cases where flying squad service is available, it should be summoned. No vaginal examination should be done there.

When a patient is thus admitted with antepartum hæmorrhage who is less than 38 weeks pregnant with the foetus alive, and is not in labour, the diagnosis is very much in favour of placenta prævia. She should be kept at complete rest in bed and a sedative administered. The routine examination should be made and special note made of B.P., pulse and hæmoglobin level. If the hæmoglobin level is not satisfactory a blood transfusion should be given.

Vaginal examination must not be done. In the majority of cases, the bleeding stops and the pregnancy can be allowed to continue. After the patient has been free of bleeding for 24-48 hours, a speculum examination should be done to visualise the cervix and rule out any cervical or vaginal lesions as the cause. Under no circumstances should a vaginal examination be made even at this stage. If the pregnancy is over 34 weeks and should it be deemed necessary to locate the

placenta to confirm this diagnosis a soft tissue radiograph may be taken. This need not be a routine. The patient is kept at rest in bed in hospital and pregnancy is allowed to continue under supervision. Should another bout of bleeding occur and the fœtus is still less than 38 weeks, the expectant line can be continued so long as the bleeding is not very heavy and labour does not start. Often these repeated bouts stop on their own and pregnancy continues. Repeated blood transfusions may be necessary. The expectant line of treatment is not persisted in when the bleeding becomes very heavy or the fœtus dies *in utero* or the patient has reached near term—38 weeks or over. Under such circumstances, active lines of treatment are undertaken.

The active line of management is indicated when (1) pregnancy is 38 weeks or over, (2) the fœtus is dead, or (3) hæmorrhage is profuse and shows no tendency to stop and systemic effects are becoming manifest.

Pregnancy over 38 weeks and/or the fœtus dead. Such cases are best examined in the operation theatre where everything is set up for blood transfusion and abdominal delivery. A gentle vaginal examination with all aseptic precautions is then made to decide the degree of placenta prævia. If it is central or posterior placenta prævia and the child is alive, it is best to do a cæsarean section immediately. In complete or central placenta prævia, even if the fœtus is dead, it is better to do a cæsarean section in the interests of the mother.

If the placenta prævia is of minor degree—Type I or II—and on vaginal examination no bleeding has been provoked, one could either induce labour by artificial rupture of the membranes or return the patient to bed to await spontaneous onset of labour. In the absence of bleeding, if the fœtus is alive, we prefer to await spontaneous onset of labour. Should she however bleed before such onset, immediate artificial rupture of the membranes will help to control the bleeding. If the fœtus is dead A.R.M. is done.

Oxytocin Drip. Stimulating uterine action by an intravenous drip of $2\frac{1}{2}$ units of oxytocin in 500 cc. of 5% glucose after artificial rupture of the membranes, should labour pains be not established within 1-2 hours of A.R.M. has proved very useful in hastening delivery and controlling minor degrees of hæmorrhage. With labour well established, hæmorrhage is controlled by the descent of the presenting part. When the head is on the perineum it is advisable to cut short the second stage by outlet forceps. In breech deliveries assistance should be given as the breech is being born. Pudendal block is the anæsthesia of choice.

If after A.R.M. and oxytocin drip stimulation the bleeding is not controlled and the child is in good condition, cæsarean section is

indicated. Where the baby is dead and mild bleeding persists, scalp traction with Willett's forceps could be employed. Very often with the descent of the head the bleeding can be controlled and since the baby is dead the mother is saved from a cæsarean section. There are many who object to the use of scalp traction. Our experience with this method, under the circumstances, has not been unhappy and we are not averse to its use. For the application of Willett's forceps the cervix should be $\frac{2}{5}$ or more dilated and the membranes ruptured. Traction with one to one and a half pound weight attached to the forceps handles and suspended over a pulley fixed to the foot of the bed is then applied. The head is thus brought to compress the placental site. The traction is not continued for more than 4-6 hours. Infection with cl. *Welchii* as a result of such traction has not been observed by us. While this procedure can be applied when the baby is alive it is associated with a higher fœtal mortality and so cæsarean section is preferred. Many authorities prefer caesarean section to scalp traction if A.R.M. and oxytocin drip does not control the hæmorrhage even when the baby is dead.

Cæsarean Section in Placenta Prævia. We have stated previously that the extended use of cæsarean section in placenta prævia has considerably lessened fœtal and maternal mortality and this became possible because of blood transfusion and antibiotics. In modern practice cæsarean section is used extensively in placenta prævia, especially to save the fœtus. The indications usually are :—

(1) All cases of central or types III and IV placenta prævia, irrespective of the state of the child.

(2) In elderly primigravida with type I or II placenta prævia with a live fœtus at about term.

(3) In types I and II placenta prævia where after A.R.M. and oxytocin drip the bleeding is not controlled and quick vaginal delivery cannot be effected. If the placenta is posterior, many obstetricians prefer cæsarean section.

(4) In all cases of severe bleeding through a closed uneffaced cervix.

These are general indications but each case has to be decided on its merits. It is accepted that in those who have been under expectant treatment for some time the cæsarean section rate will be high because of the anxiety to get a live child.

The Type of Cæsarean Section. The lower segment section is the choice in all varieties. Central placenta prævia is not considered a contra-indication for the lower segment operation. But where the patient is a poor risk and rapid delivery is indicated either on behalf of

the mother or the fœtus, classical cæsarean section may be resorted to. When the placenta is anterior, large vessels may sometimes be discovered over the lower segment. Even though the vessels can be tied off and lower segment operation done, it would not be out of place to do a classical section in these cases. When incising the lower segment, care should be taken to see that the cord is not cut as at times it presents in the incision.

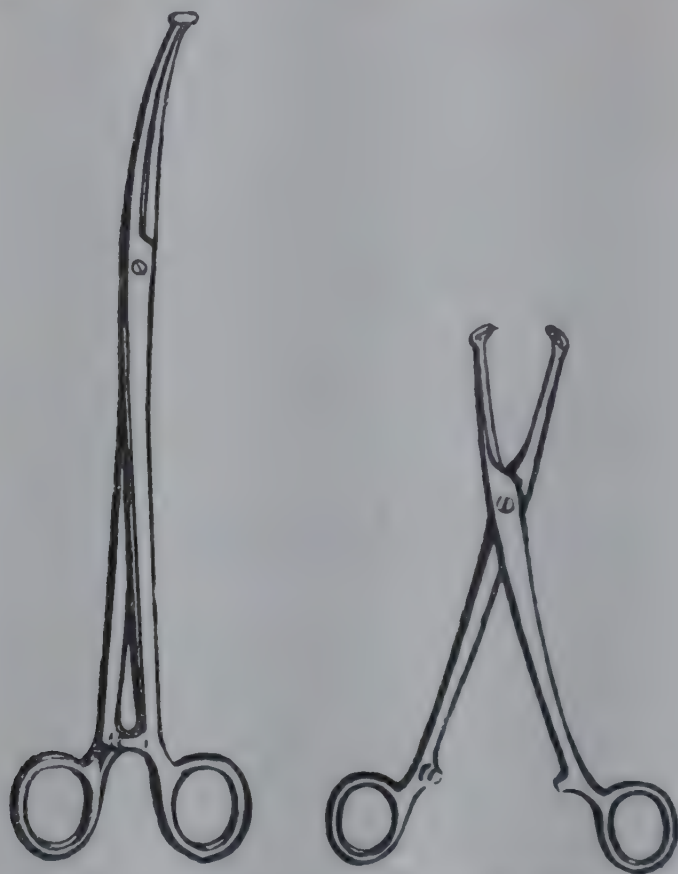


FIG. 83.—Willett's forceps. Two sizes.

Maternal and fœtal mortality. With modern management the maternal mortality has fallen from 11% to less than 2%. This marked improvement has been achieved through blood transfusion and the extended use of cæsarean section. This mortality could be reduced still further if only patients will come into hospital at the initial bleeding and continue to stay in hospital till delivery. Unfortunately many come in only after repeated bouts of bleeding has almost exsanguinate them and leave the hospital as soon as the bleeding stops.

The fœtal mortality though improved has not shown such significant improvement. In spite of the expectant line of treatment and the extended use of cæsarean section it is still in the region of 30%. This is mainly due to the necessity to terminate pregnancy in many cases when the fœtus is still premature, owing to the poor health of the mother rendering further expectant line of management very risky. Added to it is the low birth weight of infants even when born at term

Bringing down a foot in breech presentation and using the half breech to compress the placental site in incomplete varieties of placenta prævia is a useful procedure if the fœtus is dead. If this procedure is adopted when the fœtal heart is good, the fœtal mortality rate will be very high. All intra-uterine manipulations are best avoided in placenta prævia as they give rise to profuse bleeding. Internal podalic version and extraction may have a place in cases where at the time of examination the cervix is fully dilated and effaced with the head unengaged, when immediate delivery can be effected.

Apart from shock and cervical lacerations due to an unduly soft cervix retention of the placenta is occasionally encountered. Such retention is often due to the placenta being adherent and occasionally to the placenta being acreta. Manual removal of the placenta or even hysterectomy may be necessitated according to the nature and degree of adherence. Post-partum hæmorrhage also may be a sequela. The management of these complications are dealt with in detail in the relevant chapters. Occasionally post-partum hæmorrhage may occur due to blood coagulation defects.

Rupture of the Marginal Sinus. Rupture of the marginal sinus is likely to occur because of its exposed position at the placental rim, its friability and velamentous make-up of its wall—factors which predispose to rupture when it is subject to stress. Hence in the last weeks of pregnancy and during labour bleeding from rupture of the marginal sinus is likely to occur. Clinically it resembles that due to placenta prævia. The bleeding is seldom so severe as to cause maternal shock and it seldom affects the fœtus. The condition is diagnosed only on inspection of the placenta after delivery when a blood clot can be found extending through almost the entire rim of the placenta where the marginal sinus is located.

However, studies of the placenta by modern technique of electron microscopy has led to a change in the conception of the placental circulations. Thus existence of the marginal sinus is now questioned.

Placenta Circumvellata

In this type of placenta there is more or less a complete ring dividing the fœtal surface into distinct central and peripheral zones. These placentæ are usually small and thick and it is thought that the chorionic plate underlying the chorion frondosum was initially too small for the insertion of the ovum. An increased incidence of abortion is found in association with this type of placenta. More recently the frequent association of this type of placenta with non-toxic accidental hæmor-

rhage has been emphasised. It is also said that the height of the uterus may be smaller than the period of amenorrhœa, and the babies are also smaller. In between bouts of bleeding there is a watery discharge. The diagnosis is usually made after delivery.

Vasa Prævia

Sometimes blood vessels run in the membranes and if these lie over the region of the os when the cervix dilates and the membranes rupture there is profuse bleeding. The blood comes from the foetal blood vessels and hence is fatal to the foetus unless immediate delivery is effected. At times, on vaginal examination, these vessels can be felt running in the membranes. Most often the diagnosis is made only after delivery.

In conclusion, it should be stated that there exists a significant number of cases of antepartum hæmorrhage not falling in any of the varieties discussed. Some of them may fall under the so-called 'low implantation of the placenta' while the rest remain designated as 'unclassified'.

SECTION VI

PATHOLOGY OF LABOUR

CHAPTER XXXIII

OCCIPITO-POSTERIOR POSITION

THE term *Dystocia* signifies difficulty in parturition. *Eutocia*, on the other hand, implies normal labour. Several factors rise to dystocia.

Dystocia from foetal causes may be due to faulty presentation and congenital abnormalities.

Dystocia due to maternal causes may be due to abnormalities of the pelvis, and soft parts and of uterine action.

Dystocia due to faulty positions. *Occipito-posterior positions* : In a vertex presentation the occiput may be posterior and lie either on the right side of the pelvis or on the left side, the right occipito-posterior position being more common. This condition is frequently met with, and statistics show that in 25 to 30 per cent of vertex presentations the position is occipito-posterior.

Caldwell and Moloy demonstrated the influence of the shape of the pelvis on the mechanism of engagement. During the act of engagement the long axis of the ovoid head adjusts itself to the longest inlet diameter. Accordingly, oblique anterior and oblique posterior positions are more commonly found in Anthropoid types and transverse or occipito-lateral positions occur in flat forms. The influence of the pelvic shape upon head position is shown in the following table (Caldwell and Moloy).

		Gynæ- coid	An- droid	Anthro- poid	Without refer- ence to types
Posterior oblique position	..	10%	20.5%	28.5%	18.5%
Transverse position	..	69%	71%	37.5%	6%
Anterior oblique position	..	20%	8.5%	17%	16%
Direct occipito-anterior position	..	1%	0%	17%	5.5%

It will be observed that transverse positions in the Gynæcoid and Android types occur in approximately 70 per cent of cases. An increase in the number of posterior positions with a decrease in the anterior positions is characteristic of the Android type. In the Anthropoid type there is a decided increase in the number of posterior and anterior positions with a great decrease in the transverse positions. Necessarily, the mode of engagement will determine the mechanism of labour in a particular pelvis.

Diagnosis. Inspection shows flattening below umbilicus. An occipito-posterior position is usually easily diagnosed by abdominal palpation, if the uterus and abdominal walls are not too tense. The foetal limbs are more easily felt than usual, and lie nearer the middle line of the body and on either side of the umbilicus; the position of the back cannot be made out easily and is out in the flanks. The head may not be engaged in the pelvis; the anterior shoulder is usually at a higher level and farther out from the middle line than in the anterior position; auscultation reveals that the point of maximum intensity of the foetal heart sound is generally in one or other of the flanks much farther out than in an anterior position.

On vaginal examination the presenting part may be found rather high; the sagittal suture is in one of the oblique diameters, with the anterior fontanelle in one or other of the anterior quadrants of the pelvis, while the posterior fontanelle is nearer the sacral hollow in the opposite posterior quadrant.

Later in the second stage the identification of the sutures and fontanelles may become impossible due to a large caput on the presenting part. In such cases, under anæsthesia, an attempt should be made to locate the ear by vaginal examination. The pinna usually points towards the occiput.

The Course of Labour. Labour in these cases is usually prolonged. In fact, one of the commonest causes of delay in labour in a vertex presentation is an occipito-posterior position. The engaging diameter, because of a certain degree of deflexion, is the suboccipito-frontal or occipito-frontal (15 cm.). With increasing uterine contrac-

tions the head gradually descends till it reaches the pelvic floor, when forward rotation begins. Given enough time with a favourable pelvic shape and good uterine action, forward rotation of the occiput takes place in about 90% of cases. Failure of rotation in the others may be complete, i.e. the occiput remains where it was originally, when it is termed persistent occipito-posterior or it may get arrested in the transverse diameter when it is called transverse arrest, or it may move further forward and get arrested prior to full completion of rotation. When such failure of rotation occurs, spontaneous delivery is not possible. In certain cases—mostly where the pelvis is Anthropoid in shape—the occiput may rotate into the hollow of the sacrum (reversed rotation of the occiput). Under such condition spontaneous delivery with the occiput posterior is still possible. It is brought about by two kinds of mechanism: (1) The forehead in the region of the anterior fontanelle is pressed against the symphysis pubis, the head undergoes extreme flexion and the occiput is born first, sweeping well over the perineum sometimes tearing it badly. This is followed by extreme extension of the head with the birth of the brow and face. (2) Partial extension of the head persists at the beginning of labour, that part of the head in the region of the glabella or root of the nose is pressed against the symphysis pubis and the delivery is effected by extreme



FIG. 84.—Reversed rotation of the occiput.

flexion of the head, birth of the occiput followed by extension with birth of the brow and face as before. The face to pubis delivery is almost always associated with deep perineal lacerations to avoid which,

especially in a primi, episiotomy is imperative. It is also commonly associated with Arthropoid pelvis as in this pelvis the antero-posterior diameter is longer than the transverse or oblique.

Prognosis. Owing to the delay caused and the greater amount of moulding and pressure to which the head is subjected in the course of labour, the prognosis for the fœtus is not so favourable as in an occipito-anterior position. The longer duration of labour, the increased incidence of operative delivery and trauma enhance maternal morbidity.

Malrotation and Arrest. In about 10% of cases, the rotation into an anterior position does not take place and the head either gets arrested at any part between its start and the symphysis or rotates into the hollow of sacrum. When the head lies in transverse diameter, deep in the pelvis, and there is considerable delay, it is termed transverse arrest. Deep transverse arrest is often encountered when the pelvis is android in shape i.e. a pelvis with covering side walls, a straight sacrum and a narrow sub pubic arch. Many try to differentiate between delay and arrest. In these cases there is always delay, but while all arrests are also delays, all delays are not arrests. Broadly speaking, if in spite of one to two hours of good uterine contractions, after full cervical dilatation and effacement and rupture of the membranes, there has been no progress, it could be considered as arrest. The factors that help full forward rotation are (1) a good gynæcoid pelvis, (2) average sized head, (3) good uterine action, (4) rupture of the membranes after full cervical dilatation, and (5) a good pelvic floor. When these are present, forward rotation and spontaneous delivery is the usual outcome. Factors which hinder forward rotation are (1) Android pelvis or a pelvis with a straight sacrum and converging side walls, (2) large baby, say over 7½ lb., (3) premature rupture of the membranes, (4) weak uterine action, and (5) poor pelvic floor. When these are present most often forward rotation fails and delivery is usually difficult—midcavity forceps or even cæsarean section will have to be resorted to.

It is very necessary in the management of these cases to know the type of pelvis. Most of these details regarding the pelvis can be ascertained by a vaginal examination. Should however there be any uncertainty, intrapartum radiography will definitely help in deciding the level of the arrest and type of pelvis.

The first stage. Owing to delayed engagement and premature rupture of the membranes when the head is high, there is likelihood of prolapse of the cord and hence these patients are best kept at rest in bed. Pethidine 100 mgm. may be given as a sedative when labour is established. When the membranes rupture and the head is not

fixed, a vaginal examination should be done to ensure that the cord has not prolapsed. This opportunity should be utilised to check the dilatation and nature of the cervix and the exact presentation and position of the vertex. Labour is usually prolonged in these cases and hence sufficient fluids should be given to the patient to prevent dehydration. Pethidine may be repeated to obtain sedation. Uterine inertia may complicate the problem.

The second stage. With the progress of labour, the pain increases in intensity, the head descends and cervical dilatation and effacement are completed. Spontaneous delivery, after complete rotation, takes place in most of the cases, while in some others face to pubis delivery takes place.

In certain cases, progress is arrested, and in spite of strong pains, labour comes to a standstill. A difficult decision to make in these cases is when to interfere. Maternal and foetal distress are always indications for immediate interference. But in some cases help will be indicated even in the absence of such definite indications. It is wise to give the patient as much time as possible but it is not wise to wait too long. In general, it could be stated that, if in spite of a good second stage pains for an hour there is no further progress, it is best to help the delivery even in the absence of maternal or foetal distress. If assistance is too long delayed, attempts at delivery would be associated with increasing difficulty and hazards to the baby. These are only general principles and each must be individualised.

Nature of Assistance. Once a decision has been taken to interfere the mode of assistance depends on various factors. They are :

- (1) The level of arrest.
- (2) The nature of the pelvis.

The level of arrest—(1) *At the brim.* The head may be arrested at the brim itself in the transverse diameter. In such cases, if delivery has to be completed, caesarean section is to be preferred. Forceps to an unengaged head is not recommended.

(2) *In the midcavity.* This is the commonest type. These cases may be associated with a mild degree of convergence of the pelvic side walls and a straight sacrum. Arrest is usually at or above the level of the ischial spines. These cases should be examined under anaesthesia when a complete assessment of all the factors should be made. There are three methods of delivery to consider :—

- (1) Manual rotation and forceps.
- (2) Rotation with forceps and delivery.
- (3) Caesarean section.

Manual Rotation and Forceps. This method is associated with the least trauma to mother and child. It is ideal for those cases where arrest is due to the unfavourable diameter presented by a deflexed head and not due to abnormal pelvic shape. That it is not due to unfavourable pelvic shape can be made out by a proper examination under anæsthesia. If once it is decided to do manual rotation (all manipulations are under anæsthesia) the sinciput is grasped between the thumb and fingers. Slight upward pressure in the region promotes flexion and makes the rotation easier and also disimpacts the head. The vaginal hand then brings the occiput to the front, while the other hand locates the anterior shoulder through the abdominal wall and brings it towards the middle line. Both hands thus working in unison help to rotate the whole fœtus. Rotation applied to the head alone seldom rotates the trunk. Failure to rotate the trunk means that the head will almost at once return to its original position. Once rotation is completed it is wise to keep the internal hand against the side of the head until the first blade of the forceps has been applied. After completion of application it is necessary to check and see that the blades have caught the head at the ends of the biparietal diameter. The delivery is then completed. Episiotomy prior to completion of delivery will be necessary in a primigravida.

Manual rotation has, however, certain disadvantages. They are : (1) In delayed cases where the head is jammed in midcavity and there is a large caput on the head, the liquor amnii having drained away, manual rotation often fails. (2) In these cases, it may be necessary to disimpact the head first by dislodging it to a higher level and then to rotate it. This means the head has now been shifted to a higher level and forceps extraction thus rendered more difficult because of the high level. (3) Sometimes during the process of disimpaction the head may recede to the pelvic brim.

There are certain types of pelvis where manual rotation may not be suitable and may be more difficult. A pelvis with converging side walls and straight sacrum is not a very suitable one for manual rotation. The type of pelvis is also important in deciding the level of rotation and in certain types—like anthropoid, where the head has come down in occipito-posterior position—it is inadvisable to rotate it into occipito-anterior. These are best delivered as occipito-posterior. Hence, in cases where the arrest is due to abnormal shape of the pelvis, rotation with forceps is preferable.

Rotation with Forceps. Unlike in manual rotation, rotation with forceps if not carefully and properly performed can inflict major trauma to the mother and the child and this is its greatest disadvantage. But if done with care, and in selected cases, it is of great benefit.

In rotating with forceps it is first necessary to apply the blades in the cephalic manner to the sides of the foetal head so that the blades catch the biparietal diameter. This can be done by locating the posterior ear first. If the blades are applied to any other diameters, undue compression and intracranial hæmorrhage will result. Especially in transverse arrest, the blades must be accurately applied. General anæsthesia is necessary and with the hand in the vagina the exact position of the foetal head must be made out. The posterior blade is then applied after locating the posterior ear and the anterior opposite to it. Traction and rotation of the occiput to the front is then gradually and gently carried out. Often during traction the forceps itself rotates on its own, with the occiput. Sometimes, by the time the rotation is completed, the blades may be found lying in the antero-posterior diameter of the outlet of the pelvis. They may have to be removed and reapplied to complete the delivery.

For this method of delivery by forceps rotation, the usual axis traction forceps could be used. But it is more advantageous and causes less trauma if Kielland's forceps is used. These details are discussed under operative obstetrics.

In recent times the vacuum extractor has been used with good results in the management of cases of transverse arrest and occipito-posterior position. It has been found useful in cases where the cervix is insufficiently dilated and uterine action not effective.

Cæsarean Section. In certain types of cases, especially with midpelvic contraction, associated with an Android pelvis, rotation with forceps or manual rotation may not succeed. Much depends upon the obstetrician's assessment of the capacity of the pelvis. In cases where the arrested head remains high in the cavity and examination shows that at lower levels also the pelvis is not adequate, it would be safer to resort to cæsarean section rather than rotation and a difficult forceps delivery. Cæsarean section is indicated especially in the elderly primigravida under such circumstances. No hard and fast rules can be laid down in these cases. It should always be borne in mind that associated with these cases of arrest there is often a mild midpelvic contraction also, and it requires extreme nicety of judgement which comes out of only long and rich experience, whether vaginal delivery can be successfully accomplished or cæsarean section is necessary. In uncomplicated occipito-posterior position, there is scarcely any necessity for cæsarean section which is resorted to usually because of an abnormal pelvis or failure of uterine forces with unengaged head.

Uterine inertia and occipito posterior position. A very common cause for delay in labour and failure of rotation of the

occiput is uterine inertia. Weak uterine pains are common, and when they occur sedatives are administered to the patient—Pethidine usually—in the hope that efficient pains will come on later. Where such inertia persists and is not of the nature of incoordinate uterine action (discussed under anomalies of the uterine forces), intravenous oxytocin drip— $2\frac{1}{2}$ units in 500 ml. of 5% glucose—given at a rate which promotes normal uterine action, is a very useful method and often helps to avoid a cæsarean section due to prolonged labour, incomplete rotation and arrest resulting from inertia. When the head is arrested on the pelvic floor or below the level of ischial spines and the occiput is posterior, no attempt should be made to rotate it to the front. Delivery is best accomplished with face to pubis after a deep episiotomy.

Delayed Cases. Often patients are seen late in labour with the head jammed in cavity with a large caput obscuring all landmarks thus making it almost impossible to ascertain the position of the head. The fœtus in these cases is usually in a moribund condition with a very faint fœtal heart and often it is dead. Under these circumstances, if an attempt with forceps traction is not successful, it is better to perform craniotomy rather than persist in forcible injudicious attempts at traction which often results in severe maternal trauma and shock.

BROW AND FACE PRESENTATIONS

WHEN the portion of the foetal head between the anterior fontanelle and the glabella forms the presenting part because of partial extension of the head, a brow presentation results. In this presentation the head lies midway between complete flexion and complete extension, and as such the brow may be observed as a transitory presentation at the beginning of labour, later becoming converted into a vertex presentation by increased flexion, or into a face presentation by increased extension, thus assuming an attitude of greater stability.

Frequency. This is fortunately one of the rarest of cephalic presentations, and at the Government Hospital for Women and Children, Madras, in a series of 25,804 cases of consecutive confinements this presentation occurred in 28 cases, or 1 in 921.

Ætiology. Transitory presentation of the brow in the beginning of labour is occasionally observed and when labour is established it might correct itself into a face or vertex.

The causes of a brow presentation are practically identical with those giving rise to a face presentation and depend on those factors which interfere with flexion or promote extension of the head. The common causes are: (1) contractions of the pelvis, (2) large child, (3) obliquity of the uterus, (4) tumours round the neck of the child, (5) cord round the neck, (6) spasm of the sterno mastoid muscles, (7) dolico cephalic or oxycephalic head in which the head is conical, and (8) multiparity.

Although six positions are possible it is customary to talk only of two common ones—brow anterior and brow posterior positions.

Diagnosis. This type of presentation can occasionally be recognised by palpation but vaginal examination is necessary for a definite diagnosis. Abdominal palpation findings are almost the same as in a face presentation. The cephalic pole is found to occupy the pelvic inlet. The main mass of the head, i.e., the cephalic prominence, is felt at a higher level and is on the same side as the back. On the opposite side it may be possible to make out the chin at a lower level. The groove between the cephalic prominence and back and the cephalic prominence itself is less marked than in a face presentation. On

vaginal examination, the anterior fontanelle will be felt at one end of the transverse diameter, while at the other end the root of the nose and the orbital ridges may be made out. It is not possible to palpate the mouth or chin, for, when they are within reach, it is a case of face presentation.

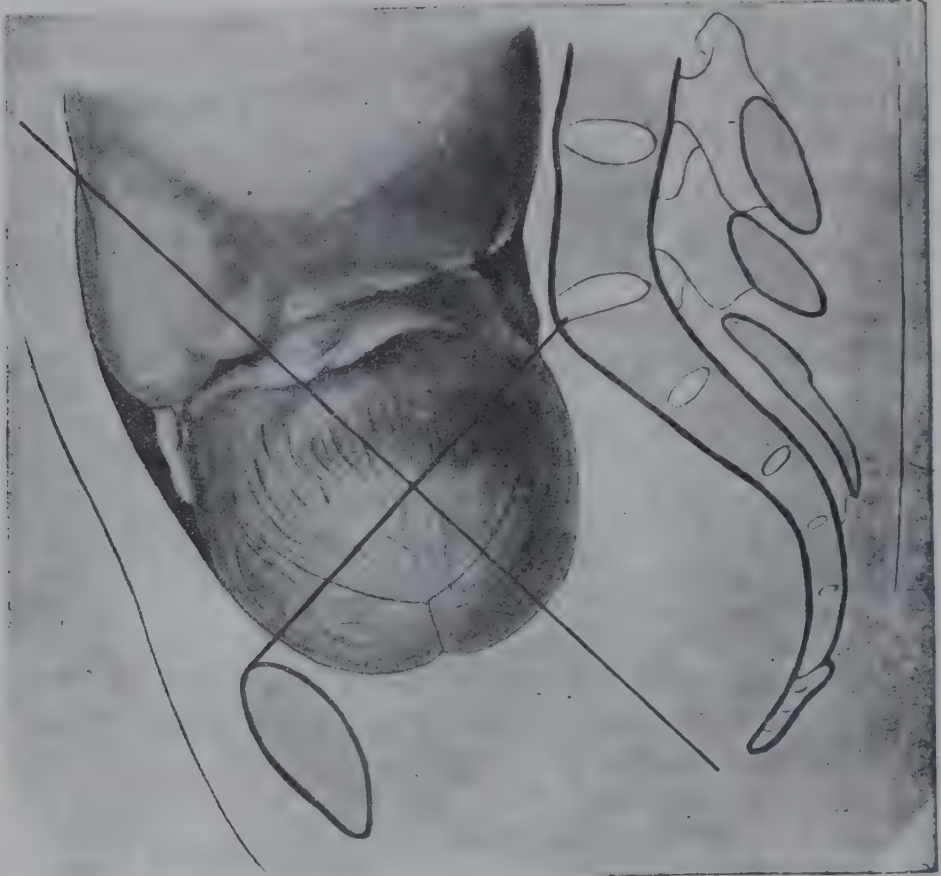


FIG. 85.—Posterior synclitism (Litzmann's obliquity.)

Mechanism. A brow presentation in many cases, owing to its instability, converts itself early in labour into a face or a vertex presentation. If it persists, progress will usually be arrested where the pelvis and fœtus are of normal size because the diameter of engagement in a brow presentation is the longest diameter of the fœtal head—the vertexo-mental—which measures 5½ ins. In cases where the pelvis is either big or the fœtal head is small owing to prematurity, moulding may take place and the brow may slowly descend into the pelvis, rotate towards the symphysis pubis until the face rests behind the pubis. In the vulva the brow covered by a large caput succedaneum appears first and then, under very strong expulsive pains, by a movement of flexion, the large fontanelle, vertex and occiput pass successively over the perineum and finally the eyes, nose mouth and chin appear from behind the pubis with one movement. Sometimes the head is delivered up to the mouth before the occiput escapes. After delivery of the head, shoulder rotation and restitution occur as in a vertex presentation. Extensive lacerations may result from this mechanism.

Prognosis. The prognosis for both mother and foetus is unfavourable unless assistance is available and proper treatment is adopted.

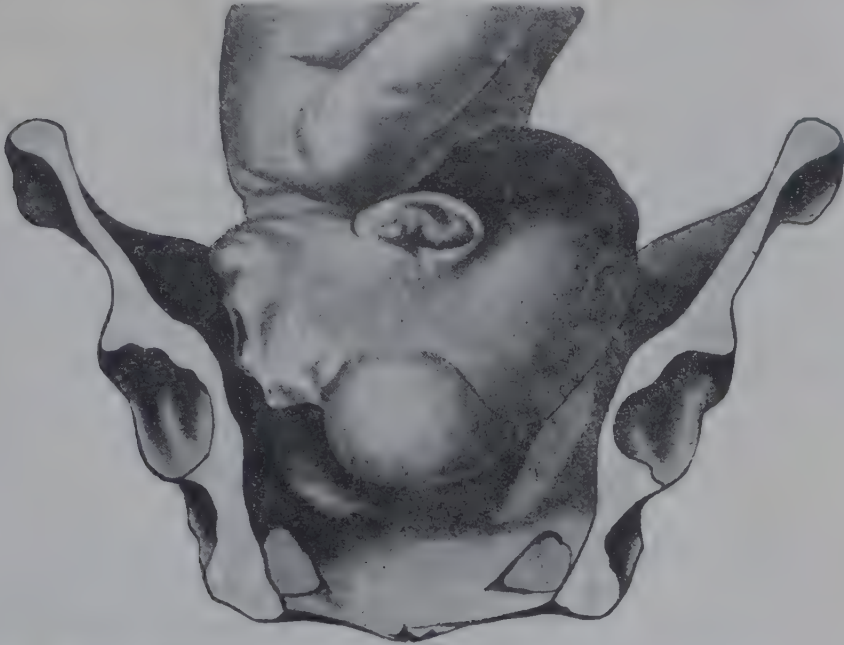


FIG. 86.—Engagement of the head in a brow presentation.



FIG. 87.—Moulding and caput in brow presentation.

ted. The dangers to the mother result from obstructed labour; namely shock and severe laceration of the parturient canal, including rupture of the uterus, if assistance is not available in time.

The dangers to the child are intracranial injuries and asphyxia, and injury from operative procedures.

Management. The treatment of brow presentation is intelligent expectancy, except when the pelvis is contracted and the baby is large, when caesarean section should be performed early in labour. In about 30-40% of cases the brow may convert itself into face or vertex during

labour and spontaneous delivery may take place. In cases where brow presentation persists even after the rupture of the membranes an attempt may be made, under anæsthesia in the second stage, to convert it into a face presentation—mento-anterior, which will be more easy than converting it into a vertex. If this is successful, the patient may be left alone for spontaneous delivery, or if conditions are satisfactory for immediate delivery, it could be completed by forceps. Should, however, conversion is not possible and brow is persistent, cæsarean section would be a wiser procedure. In delayed cases, where the brow is arrested with a large caput and fœtus is dead or moribund, craniotomy will have to be performed to complete delivery. Fœtal mortality in mismanaged cases is in the region of 40%.

Face Presentation

This is the result of complete extension of the head. Among

25,804 deliveries there were 110 cases of face presentations, an incidence of 1 in 235. In face presentation, the chin is the denominator and the part of the cephalic pole which lies between the chin and the frontal eminence tries to engage in the pelvis.



FIG. 88.—Face presentation.

Aetiology. Among the factors responsible for the causation of a primary face presentation are:—

(a) Intrinsic factors connected with the fœtus, such as, anencephaly, dolichocephalic head, tumours of the neck, twist of the cord several times round the neck and spasm of the extensor muscles of the neck.

(b) Extrinsic factors—for example, contractions of the pelvis, obliquity of the uterus, multiparity.

Positions. The chin being the denominator the positions are:—

- | | | |
|------------------------------------|------------------|--------|
| (1) Right mento-posterior (R.M.P.) | corresponding to | L.O.A. |
| (2) Left mento-posterior (L.M.P.) | " | R.O.A. |

- | | | |
|-------------------------------------|---------------|--------|
| (3) Left mento-anterior (L.M.A.) | corresponding | R.O.P. |
| (4) Right mento-anterior (R.M.A.) | " | L.O.P. |
| (5) Left mento-transverse (L.M.T.) | " | L.O.T. |
| (6) Right mento-transverse (R.M.T.) | " | R.O.T. |

The commonest position is Left mento-anterior (L.M.A.)

Diagnosis. On abdominal palpation the characteristic sign is the palpation of the cephalic prominence on the same side as the back instead of on the side of the small parts as in vertex presentation. The back is distinctly felt only near the breech. The foetal heart is best heard below the umbilicus and when the back is posterior it is heard with great distinctness. While these signs might be suggestive the diagnosis of a face presentation can be confirmed only by radiological or vaginal examination. A straight Xray of the abdomen will reveal the diagnosis.

On vaginal examination the distinctive features of the face are the mouth and nose the malar eminences and orbital ridges. At times a breech may be mistaken for a face since the anus may be mistaken for the mouth. The ischial tuberosities are always in a line with the anus whereas the mouth and malar eminences are not. This factor helps in avoiding the mistake.

Mechanism. The part played by the occiput in a vertex presentation is simulated by the chin in a face presentation. The movements which help to deliver the face are :—

- (1) Descent with increased extension,
- (2) Internal rotation of the chin,
- (3) Flexion,
- (4) Restitution,
- (5) External rotation.

At the beginning of labour the head is fairly high and may not always be in an attitude of complete extension. When labour starts and descent begins, an exaggeration of extension takes place. The chin becomes the most dependent part and the face engages by its cervico-bregmatic diameter in one or other of the oblique diameters of the pelvis. As the head descends, the chin meets the pelvic floor first and anterior rotation of the chin occurs so as to bring it well underneath the symphysis pubis. After it becomes fixed there, flexion occurs. As a result of this, the mouth, nose, forehead and sinciput escape sweeping over the perineum. As soon as the head is delivered, restitution takes place, as in a vertex presentation, as also external rotation of the head corresponding to the movement of internal rotation of the shoulders. The rest of the body is delivered thereafter.

In cases where the chin is anterior at the time of the onset of labour, internal rotation takes place through one-eighth of a circle. Where

the chin is posterior, as in right mento-posterior and left mento-posterior positions, the chin rotates through the larger arc of the circle, that is, through three-eighths of a circle (135°).

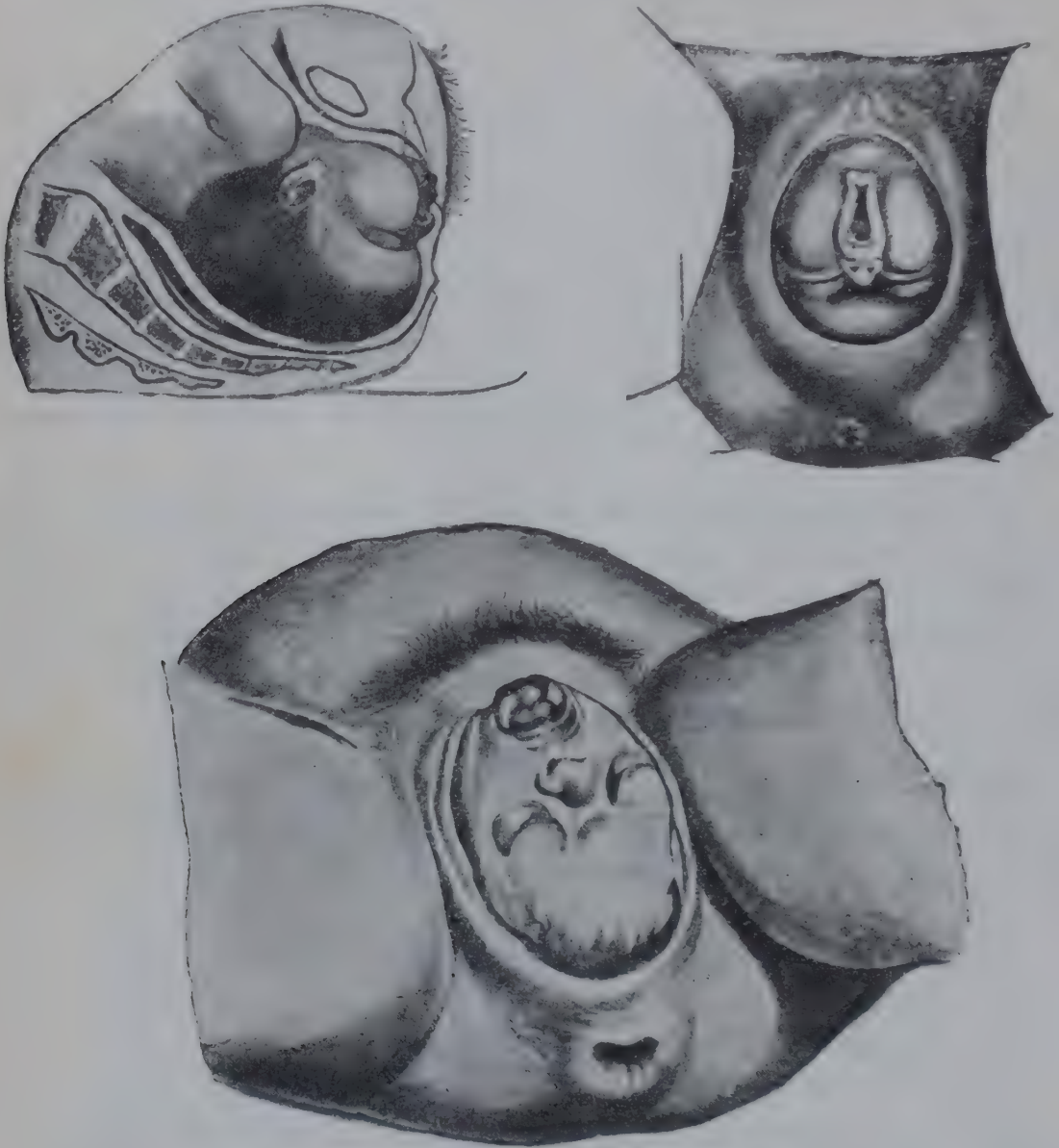


FIG. 89.—Delivery of the face in a face presentation.

Abnormalities may occur in rotation. The chin may not rotate at all, or it may be arrested at any stage in the movement of internal rotation, or again the chin may rotate into the hollow of the sacrum.

When the chin remains posterior, further efforts at delivery only impact the face more tightly, as with each attempt to push the head down a portion of the neck and the body of the fœtus is also pushed down simultaneously so that the diameter of the engaging part becomes increased by the thickness of the chest of the fœtus. While in occipito-posterior positions delivery as occipito-posterior is possible in face presentations delivery as mento-posterior is impossible. If no help is available the fœtus dies from asphyxia and the mother from rupture of the uterus.

Clinical Course. Most cases of face presentation with the chin anterior are delivered by natural efforts, as in these cases the diameter

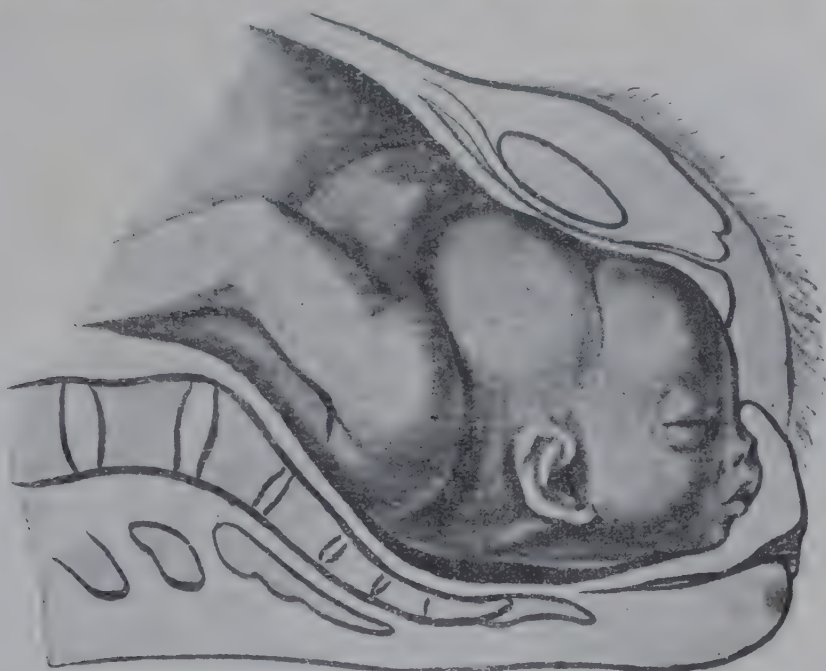


FIG. 90.—Impacted mento-posterior.

of engagement, the submento-bregmatic, is equivalent in length to the suboccipito-bregmatic, which engages in a vertex presentation. If, therefore, there be no disproportion between the head and the pelvis due either to contraction of the pelvis or to the increased size of the head, and if the chin is anterior, a face presentation is generally delivered spontaneously. The possibilities of premature rupture of the membranes and prolapse of the cord should, however, be borne in mind.

When the chin is posterior, however, reverse rotation of the chin may take place, and then further progress is impossible.

Prognosis: Mother. The risks to the mother are increased in mento-posterior position because of prolonged labour and increased necessity for major obstetric interference.

Child. Here the prognosis is definitely worse. The foetal mortality in face presentations varies between 15 and 20 per cent as compared with a mortality of 2 to 3 per cent in vertex presentations. The increased risk is mainly in mento-posterior position where the chances of mal-rotation, prolonged labour resulting in asphyxia and obstetric interference and trauma are sometimes unavoidable.

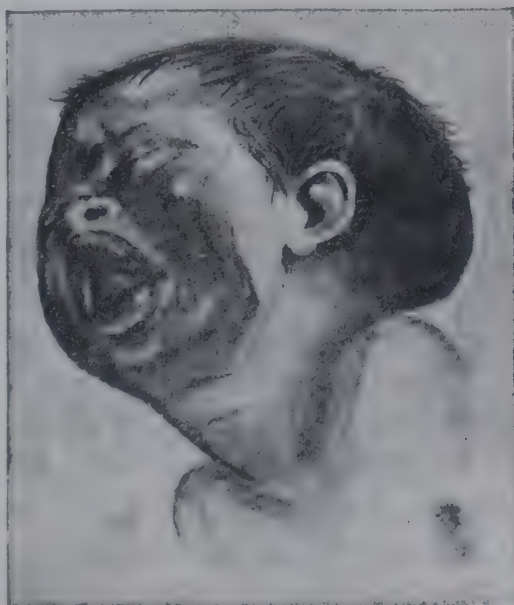


FIG. 91.—Caput in face presentation.

Frequently, owing to the caput that is formed about the mouth and face, and possibly also because of a certain amount of œdema of the larynx and trachea, the child is unable to cry lustily and often has a hoarse voice for two to three days after delivery, and for the same reason, is not able to suck at the breast during that period.



FIG. 92.—Caput and moulding in face presentation.

Management. When a face presentation is diagnosed, a careful study of the pelvis should be made, including radiopelvmetry in the antenatal period, to rule out a pelvic contraction at all levels as the cause of the face presentation. If no such cause is found and the baby is not

unduly large, the management depends upon the position of the chin. If the chin is anterior as made out by radiography or vaginal examination early in labour, the case can be dealt with as in vertex presentations. No attempt at converting a mento-anterior into a vertex should be made, as the resulting position is occipito-posterior, which is less favourable.

There is, however, a greater tendency for premature rupture of the membranes and delayed engagement of the presenting part. With increasing uterine contractions, the face descends to the pelvic floor and is usually delivered spontaneously. An episiotomy, especially in a primi, is a necessity. Should there be delay at the outlet, delivery can be easily completed by forceps. The foetal mortality is not usually higher than in a vertex presentation.

Management of mento-posterior position. When the chin is posterior, every attempt should be made to rule out a pelvic contraction. If however it is present, or the baby is large, it would be wiser to resort to cæsarean section.

In cases where such factors are not present, vaginal delivery should be given a trial. Given enough time, with uterine action, in 75-80% of cases forward rotation takes place. In the rest, labour comes to a standstill as a result of persistent mento-posterior position or impaction. Except under exceptional circumstances cæsarean section is the treatment of choice in the interests of the child. In some cases where the face has descended deeply into the pelvis under general anæsthesia manual or forceps rotation of a posterior chin to an anterior presentation may be attempted. If the child is dead perforation of the foetal skull is the treatment of choice.

Manual conversion of the posterior chin into a vertex presentation was in vogue but is now seldom employed as most often it failed. Internal podalic version and extraction is associated with high foetal mortality and some risk to the mother and is now not recommended. It has to be borne in mind that the conversion operations do result in some trauma to the foetus and they are successful in only half the cases. When they fail and the foetus is alive the only recourse is caesarean section, an operation which is made more hazardous by the manipulations inherent in the attempted conversion.

One of the common complications is uterine inertia. In mento-anterior position when such inertia occurs, an intravenous Oxytocin drip containing $2\frac{1}{2}$ units of Oxytocin in 500 cc. of 5% glucose is very helpful. The rate of the drip is so adjusted as to give rise to normal uterine action. With the onset of such pains induced by the Oxytocin drip, labour usually progresses favourably. The use of Oxytocin drip in mento-posterior positions is highly controversial. Perhaps it is best avoided.

BREECH PRESENTATION

Varieties. There are two varieties of breech presentation :—

- (a) Complete.
- (b) Incomplete.

Complete breech is one where the fœtus maintains the attitude of universal flexion with the thighs flexed at the hips and legs at the knees.

In cases of *incomplete breech*, on the other hand, the attitude of universal flexion is disturbed and varying degrees of extension occur at the podalic pole. Thus one may meet with cases of :—

- (a) *Frank breech* or *extended breech*, where both the thighs are flexed, but the legs are extended so that the lower limbs lie along the ventral surface of the child's trunk.
- (b) *Knee presentation*, where the thigh is extended at the hip but the leg is flexed at the knee.
- (c) *Footling*, where the thigh is extended at the hip and leg at the knee.

In knee and footling presentations one or both the extremities may be involved.

Frequency. The frequency of breech presentations is variously estimated, but it may be said that it generally occurs once in about fifty cases. At the Government Hospital for Women and Children, Madras, there occurred 972 cases of breech deliveries among 25,804 confinements—an incidence of 3.7%.

Among these 972 cases 230 were in primigravidæ and 742 in multi. Of the 230 in the primi, 121 (52%) were extended breech presentations, while among the 742 breech presentations in multigravidæ, extended legs were found in 306 or 40%, demonstrating that breech with extended legs is more common in the primigravida.

Aetiology. Anything which interferes with the normal shape of the fœtal ovoid or changes the shape of the uterine ovoid may result in a malpresentation, such as breech. The factors favouring a breech presentation are obliquity of the uterus, multiparity, uterine fibroids,

placenta prævia, ovarian tumours, contractions of the bony pelvis. An important factor in repeated breech presentation is a septate uterus. Other factors are hydramnios, prematurity, multiple pregnancy, monstrosities and foetal anomalies such as hydrocephalus.

The co-existence of several of these factors is frequently seen in a given case. In 40-50% of cases no ætiological factors are made out. Cornual implantation of the placenta is said to occur more commonly in association with breech presentations.

Positions. Four positions are described. The sacrum is used as the denominator in breech presentation, and depending on the position of the sacrum, a breech may present as :—

- (1) Left sacro-anterior (L.S.A.) which is the commonest.
- (2) Right sacro-anterior (R.S.A.).
- (3) Right sacro-posterior (R.S.P.).
- (4) Left sacro-posterior (L.S.P.).

Mechanism of labour. The breech enters the brim of the pelvis with the bis-iliac diameter in one or other of the oblique diameters. In the left anterior position it is the left oblique diameter ; in the right anterior position it is the right oblique diameter.

Before labour commences the breech does not enter the brim of the pelvis as the cephalic pole would, so that the presenting part is felt higher up and not engaged. When, however, labour starts the first movement is descent with compaction. *Compaction* means that every part of the body becomes a little bit more flexed, the same movement in reality that takes place in a vertex presentation where the increased flexion permits a smaller diameter to engage in the brim of the pelvis. This descent with compaction drives the breech down through the pelvis till the anterior buttock reaches the floor of the pelvis when the second movement takes place, namely, *internal rotation*. It always results in the anterior buttock moving towards the symphysis pubis through one-eighth of a circle ; whether the sacrum is in the anterior or posterior position there is always one buttock anteriorly which can move through one-eighth of a circle and thus bring the buttock to the symphysis pubis. After internal rotation has taken place the next movement is *latero-flexion*. This movement is in reality the counter-part of the movement of extension in a vertex and flexion in a face presentation. It is only by latero-flexion that the breech is able to pass through the cavity and present at the outlet. The breech then distends the perineum and is born. Once the breech has been delivered outside the vagina, the body slips out ; the shoulders now engage in the same oblique diameter as the breech, and by the movement of internal

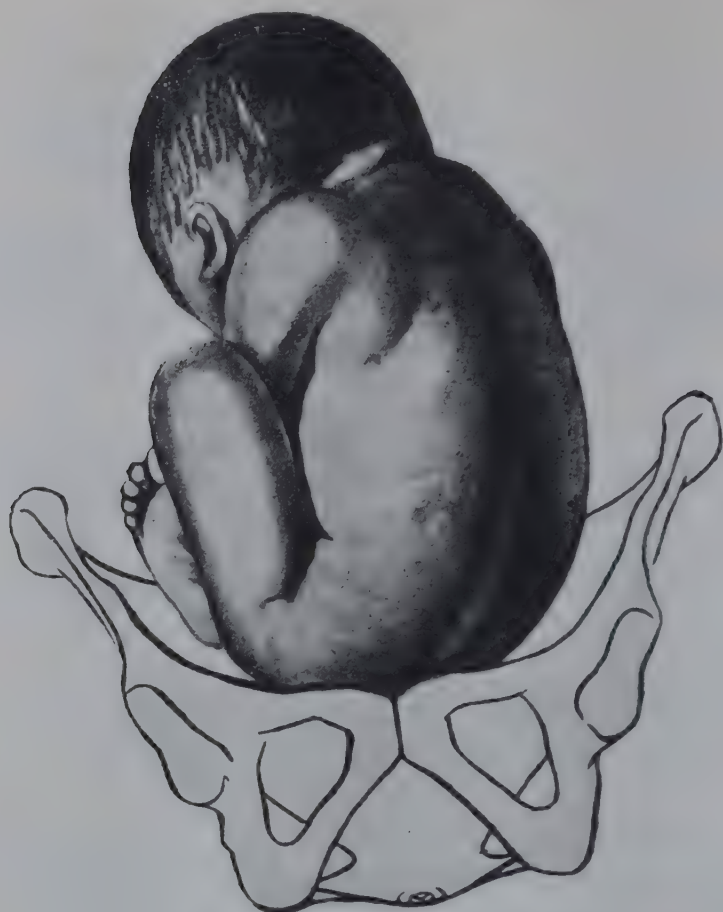


FIG. 93.—Breech presentation—L.S.A.



FIG. 94.—Breech presentation—R.S.P.

rotation the anterior shoulder hitches against the symphysis pubis, the posterior shoulder sweeps over the perineum and is born first, the anterior shoulder following later. After descent of the shoulders the head engages in the opposite oblique diameter; if the breech had passed through the left oblique diameter the head would engage itself in the right oblique diameter. Rotation takes place, bringing the occiput underneath the symphysis pubis, and then by a movement of flexion the head is born.

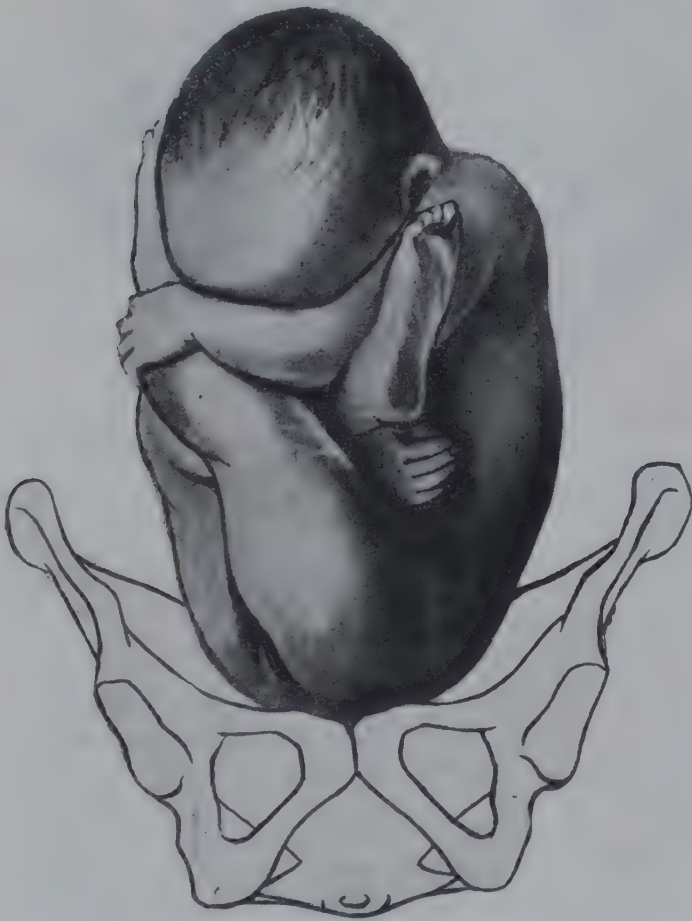


FIG. 95.—Breech presentation with one leg extended.

The mechanism of a breech presentation, therefore, is a little more complicated than the mechanism of a vertex or a face presentation. The head like the breech has to go through a mechanism before it can be born, namely, internal rotation, with increased flexion. In fact, the mechanism in breech delivery consists of three stages; delivery of the breech, delivery of the shoulders and delivery of the head. Occasionally, when the back is posterior, the movement of internal rotation of the breech carries the body to the opposite oblique diameter; in other words, when the back is posterior the anterior buttock rotates not merely through one-eighth of a circle but through one-fourth of a circle to the opposite side, and the back which was posterior becomes anterior, so that the further stages of delivery present no difficulty. Sometimes the after-coming head in a posterior position fails to rotate

with the trunk anteriorly, and so adopts a persistent occipito-posterior position. If the head is small and spontaneous delivery is possible;



FIG. 96.—Mechanism of delivery in a breech. Latero-flexion.

the face slips down behind the symphysis pubis and the chin is born first, but usually labour is held up.

Diagnosis. *Abdominal palpation.* On palpation, the cephalic pole will be felt at the fundus of the uterus and can be differentiated from the breech in that position by the fact that the head is smaller, harder, and more movable and it ballots independently of the rest of the body. Umbilical grip will reveal the presence of the back on one side and the limbs on the other. By means of the pelvic grip the large breech is felt at the lower pole, and it can be recognised as such since it moves with the rest of the body and is softer than the head.

Auscultation is also of help. The fœtal heart will be heard above the level of the umbilicus either to its right or left, depending upon the position of the back. It will be heard nearer the middle line, when the back is anterior and further out when the back is posterior. Radiography makes the diagnosis certain.

Vaginal examination. A breech presentation is made out on vaginal examination by the palpation of the ischial tuberosities on either side with the anus in the middle and the sacrum behind. In complete breech the feet can be felt by the side of the buttocks while in extended breech the feet are not felt. In footling presentation one or both feet may be felt hanging down into the vagina. Sometimes the external genitalia may be made out.

The anus may sometimes be mistaken for the mouth and a foot for the hand. These errors can usually be avoided by a careful examination. When a finger is introduced into the anus the grip of the finger is usually felt and there may also be staining with meconium. The heel helps to differentiate between foot and hand.

Prognosis. *Mother.* The maternal morbidity is slightly higher than in vertex presentations because of the increased incidence of interference.

Child. There is no doubt that, as far as delivery is concerned, vertex presentation is safest for the baby. The foetal mortality in breech delivery shows wide variations—from 2% to 30%. This is mainly due to the fact that, in quite a number of cases, there are complicating factors which by themselves increase or add to the foetal risk. Hence it is necessary, when assessing the inherent risk to the foetus in breech deliveries, to discard the accentuating factors and then assess the risk. For this purpose it is customary to divide breech delivery into two main groups—the complicated breech and uncomplicated breech. By complicated breech is meant delivery associated with factors detrimental to the foetus—namely prematurity, maternal toxæmia, antepartum hæmorrhage, foetal abnormalities, contracted pelvis and other maternal diseases like hypertension, cardiac disease, etc., which adversely affect the foetus. In the uncomplicated breech deliveries there are no extraneous factors which affect the foetus adversely. Extended legs, extended arms, prolapse of the cord, difficulty in delivering the after-coming head, are all risks inherent in a breech delivery and these should not be classed as complicated breech if they occur during delivery. The following factors must be taken into consideration in assessing the foetal risks :

(1) *Age and parity of the mother.* Breech in a primigravida is associated with a higher foetal mortality. If the primigravida is over 35 years of age the foetal mortality would appear to be still greater.

(2) *The weight of the baby.* Foetal mortality is higher in infants of less than five pounds and more than eight pounds. In the former it is due to prematurity, while in the latter it is due to difficulties encountered during delivery.

(3) *The type of breech.* Extended breech has slightly less foetal mortality than full breech, the reason being that in the latter condition prolapse of the cord and expulsion of the breech before full cervical dilatation are more common, which endanger the foetus.

(4) *Pelvic configuration.* High foetal mortality should be anticipated in patients with Android pelvis or midcavity contractions.

(5) *Uterine dysfunction.* If the labour is complicated by abnormal uterine action foetal mortality is enhanced.

(6) *Other complications.* Any maternal or foetal complications complicating a breech delivery will adversely affect the foetal mortality.

(7) *The skill of the obstetrician.* Especially in breech delivery the skill of the attending obstetrician will make all the difference to the foetus. There is no doubt that the less skilled the obstetrician, the greater is the foetal mortality.

The mortality is further enhanced by injuries that are sometimes inflicted on the child during delivery. Intra-cranial hæmorrhage due to tentorial tears is a common cause of foetal death in breech delivery. Fractures of long bones—femur and humerus—are met with in difficult breech deliveries. Asphyxia is a prolific cause of foetal death.

Management. *Antenatal period.* When a breech presentation is found to persist in a primigravid woman after the 34th week of pregnancy, every attempt should be made to find out the ætiological factor. In particular, the pelvis should be suspected and radiopelvimetry should be done to rule out any contraction. If contracted pelvis is diagnosed or any other ætiological factor is identified, the treatment will depend upon the factor responsible. If no ætiological factor is demonstrable, the question of external version to convert the breech into a vertex arises.

The place of external version. Upto 34th week of pregnancy breech presentations are common. Many breech presentations by that period spontaneously correct themselves into vertex presentations. After the 34th week the incidence of such spontaneous corrections significantly drops down and after the 36th week it is rather rare. Hence it is suggested that if a breech presentation is found to persist after the 34th week, it is better to try and convert it into a vertex. At this period the correction is more easy and the chances of recurrence after correction are diminished. Later in pregnancy the difficulties of conversion are greater because of the increasing size of the child and the diminishing liquor amnii.

Is it necessary to correct all breech presentations into vertex? This can be answered only by comparing the foetal mortality of successful external version and vertex delivery with that of breech delivery as such. In a carefully executed external version the foetal mortality due to this procedure is less than 1% and even in the best of hands, especially in a primigravida, the foetal mortality for breech deliveries is higher than with a vertex after external version. Hence there is definitely

a case for external version in all primigravida. The case is further strengthened when the pelvis is borderline, for a vertex presentation permits a trial labour, while with a breech no such trial is possible.

While there are many who hold the view that every case of breech presentation must be converted into a vertex, we believe that in a multigravida, with a good obstetric record, such a procedure is not imperative. The hazards of a breech delivery are much less. If the attending obstetrician has not enough experience or confidence in dealing with breech deliveries, he should make every attempt to convert a breech delivery into a vertex.

Contra-indications for external version. Contraction of the pelvis, foetal abnormalities, like hydrocephalus, maternal toxæmia, plural pregnancies, congenital abnormalities of the uterus usually contra-indicate external version. Extended legs are not a contra-indication but they make the procedure difficult.

Precautions necessary during external version. All movements must be gentle. The flexion attitude of the foetus must be maintained. Anæsthesia is best avoided, as otherwise one may not be able to gauge the degree of force used. However, it will be necessary in patients with tight abdominal muscles and who are nervous and non-co-operative. All forcible movements must be avoided. During the procedure the foetal heart sounds must be listened to frequently. If any alterations in the foetal heart are noticed, the procedure must be stopped. After a successful version a pad and binder may be placed over the abdomen to help the foetus to remain in the corrected position. Any assessment of cephalopelvic disproportion should be done only two to three days later as the deflexion of the head would have corrected only by that time.

There is no objection to repeated attempts being made at intervals, if attempts have been unsuccessful or if the foetus reverts back as breech after a successful attempt. But extreme care and gentleness are required. If much difficulty is met with, it is better not to persist with correction.

It is customary to include accidental hæmorrhage, foetal death due to twisting of the cord round the foetus and even rupture of the uterus among the complications of external version. We believe these are rare and mostly the result of injudicious attempts at version.

When external version has failed, the problem arises how best to effect the delivery. If ætiological factors like contracted pelvis, tumours complicating pregnancy, elderly primiparity, etc., are obvious, cæsarean section would be indicated. In those with no such ætiological factors a decision for vaginal delivery is usually made. Even if the pelvis is adequate, it is advisable to bear in mind that a foeto-pelvic disproportion

may exist if the baby is large—over $7\frac{1}{2}$ pounds. If this is evident, cæsarean section, especially in a primigravida at term, should be considered. We are not in favour of induction of premature labour to enable a smaller baby being born as a breech. In all those cases where a vaginal delivery is decided upon, it is best to keep an open mind so that, if complications arise during the course of labour, cæsarean section may have to be done at times to save the child.

Once vaginal delivery is decided upon, there are three methods usually adopted.

- (1) Spontaneous breech delivery.
- (2) Assisted breech delivery.
- (3) Routine breech extraction.

Spontaneous Breech Delivery. There is very little difference between spontaneous breech delivery and assisted breech delivery; for all breech deliveries at term require assistance in the delivery of the head and some in the delivery of the shoulders also. Hence planned assisted breech delivery is preferred. We are not in favour of routine breech extraction which is recommended only when there is a definite indication.

Assisted Breech Delivery. Soap and water enema to clear the lower bowels is given at the onset of pains. Premature rupture of the membranes is a common feature during a breech delivery. Though it may not be prevented, it is advisable that patients with full breech presentation are at rest in bed from the commencement of the first stage. The fœtal heart rate should be observed at least every hour and after rupture of the membranes more frequently; sedatives need be administered only after labour pains are well established. Pethidine—100 mgms. intramuscularly repeated if necessary every 4-6 hours. With increasing uterine contractions, the breech begins to descend. With an extended breech, engagement occurs earlier than with a fully flexed breech. In the latter variety premature rupture of the membranes and prolapse of the cord are more common. When the membranes rupture it is advisable to make a vaginal examination to note the dilatation, nature of the cervix, type of breech and its position. In the absence of any prolapse of the cord, labour is permitted to continue.

With the descent of the breech to the pelvic floor, the pains increase in intensity and frequency and the breech appears at the vulval outlet. At this stage the patient should be brought to the edge of the board and the legs put in the lithotomy position or held up by two assistants and the obstetrician washes up and gets ready to assist. When the baby's anus is visible at the vulval outlet, pudendal block anæsthesia is induced and medio-lateral episiotomy done. The timing of the episiotomy is

important. It should not be done too early. It is best done when, in between contractions, the baby's anus is visible at the vulval outlet. Episiotomy should always be done in a primigravida and often it is needed in multiparæ. Failure to do so might occasionally give rise to difficulty in the delivery of the after-coming head. With increasing uterine contractions the breech emerges out of the vulval outlet. With a fully flexed breech sometimes a foot may be caught in the vagina which should be released by hooking it out with the finger. With further contractions and straining by the patient the baby is born as far as the umbilicus. At this stage the obstetrician must take care to see that the baby's back is facing him. He should now draw down a loop of the cord and keep it away to one side to prevent it from being compressed and the baby's body should be covered with a sterile towel to prevent premature attempts at inspiration as a result of external cutaneous stimuli. The body of the baby is steadied but the obstetrician must not make any traction from below. Gentle fundal pressure during pains is helpful. With further efforts on the part of the patient the axillary folds of the baby come into view under the symphysis. Ordinarily, the arm being flexed at the elbow and shoulders, it is easily born. Usually the posterior arm is born first and then the anterior. If it is not flexed and if there is delay, we prefer the Lovset manœuvre to deliver the arms. Steady and gentle traction downwards on the



FIG. 97.—Method of delivery of the breech.

Note the method of holding the breech in traction.

feet with the back of the baby facing right or left usually helps to bring the axillary fold into view under the symphysis. As soon as the shoulder is seen under the symphysis, a finger is passed along the arm down to the elbow which is then flexed. The hand drops down. The baby is then rotated till the posterior shoulder comes under the symphysis and the same manœuvre is repeated. This manœuvre is not necessary as a routine; when the arms are well flexed, most often they are born spontaneously. Lovset manœuvre is resorted to only when the normal mechanism fails. After both arms are thus delivered, the child hangs down from the vulval outlet with its back directly facing the obstetrician. It is then caught hold of by the feet and gentle but steady traction maintained till the occiput is seen under the symphysis which is usually the case when there are no complications in the mechanism of delivery. By allowing it to hang down from the vulval outlet for a few minutes the entrance of the head into the cavity is made easier by the action of gravity. Should further assistance be required, it is given by moderate suprapubic pressure on the head which will promote flexion and descent. Once the occiput is seen under symphysis, the obstetrician with steady traction on the feet swings the fœtus in an arc over the mother's abdomen. This manœuvre must be carefully executed and care must be taken to see that the head does not suddenly come out of the vagina. The episiotomy already performed gives enough room for safe passage of the head which can be controlled. When the baby's mouth is seen at the vulval outlet, the throat can be cleaned and mucus sucked out and delivery of the head is completed. This method of delivery of the head is known as 'Marshall-Burns technique'.

Some obstetricians at this stage prefer to deliver the head by forceps. We use the Marshall-Burns technique as described above in delivering the head but seldom use the forceps as a routine. If difficulty is experienced after the head has entered the cavity, either Mauriceau-Smellie-Viet technique to be described later or the forceps is used. In Mauriceau-Smellie-Viet method the fœtus is supported astride the left forearm with the index or middle finger in the mouth. The index and middle fingers of the right hand are then slipped over the clavicles from behind. Traction is made downwards until the nape of the neck appears when the direction is changed and the fœtus swung up over the mothers' abdomen. Suprapubic pressure over the head is combined with the manœuvre. The advantage claimed for the routine use of forceps is that it helps to control the exit of the head.

Before starting to assist breech delivery, all arrangements must be made to treat neonatal asphyxia. Each step of the assistance should be planned as a deliberate move and not haphazard. There should be no panic, especially in the delivery of the arms and the head. There is no necessity to hurry and complete the delivery in a minute or two. Five to seven minutes is not a long interval and will not adversely

affect a well oxygenated baby. The umbilical cord pulsation will give an indication of the baby's state.

The third stage of labour is managed on the usual lines. But prophylactic use of oxytocics prior to the completion of the delivery is not recommended.

Complications in Breech Delivery. Many complications may occur during a breech delivery—some of them may result in foetal death and maternal trauma.

(1) *Premature rupture of the membranes and imperfect dilatation of the cervix.* This is a very common feature in breech deliveries—more common in full breech and footling presentation due to the presenting part imperfectly fitting into the lower uterine segment. It cannot be prevented and to some extent affects adversely the foetal prognosis in that the prolongation of labour and intrapartum infection are more likely to occur.

With premature rupture of the membranes and partially dilated cervix sometimes the foot slips out in a full breech presentation. No attempt should be made to extract the breech when the cervix is not fully dilated and taken up. Such attempts will often end in tears of the cervix, difficulties in delivering the arms and head ending most often in still birth. It is far better in the absence of maternal or foetal distress to leave these cases alone for spontaneous delivery, in the hope that with further pains cervical dilatation may progress to completion. Unfortunately, in most cases, by that time the baby is also born up to the umbilicus at least. Should it be imperative to complete delivery in some cases, the cervix may have to be incised to complete dilatation and delivery.

(2) *Prolapse of the cord.* It is difficult to give the exact incidence of this complication except to state that it is common in full breech and more common with footling presentation for the same reasons as mentioned in the previous paragraph. With extended breech, prolapse of the cord is uncommon. The prolapse may occur when there is insufficient dilatation of the cervix to complete the delivery in which case the foetal mortality is enhanced unless immediate caesarean section is resorted to. Prolapse of the cord is always an indication for immediate delivery if the baby is to be saved. When the cord prolapses after full cervical dilatation, breech extraction should be done to save the child.

(3) *Extended arms.* Ordinarily the arms are well flexed and easily delivered during an assisted breech delivery. However, at times, one arm or both may be extended. Extension of the arms is at times produced by traction from below on the foetus, and occasionally may

be due to the delivery of the baby through an insufficiently dilated cervix. When such difficulty is encountered, it can most often be dealt with by the Lovset's manœuvre already described in assisted breech delivery. Should this manœuvre fail, an attempt should be made to deliver the posterior arm first. For this, first the baby should be held up and to one side by its feet and a hand is passed into the vagina. It passes into the hollow of the sacrum and along the side of the baby's arm till its elbow is reached which is now flexed and brought down in front of the baby's body. It should never be brought across the back as it will certainly fracture the humerus. Once the posterior arm is delivered the anterior one can be delivered as in Lovset's manœuvre or should there be difficulty, the baby can be rotated so that the anterior arm is made posterior and the delivery completed by the technique mentioned. Particular care should be taken to see that all movements are gentle and deliberate. Else the humerus is likely to be fractured. A narrow sub-pubic arch may cause extension of the arm and considerable difficulty in its delivery.

(4) *Nuchal position of the arms.* This is not a common complication. This term is applied to denote that the hand is behind the occiput. One or both arms may be in nuchal position. The diagnosis is made only when the obstetrician finding difficulty in delivering the arms passes his whole hand into the lower uterine segment when he feels the hand behind the occiput. He should then ascertain the direction in which the fingers are pointing. The treatment is to rotate the baby in the direction in which the fingers are pointing. The arms drop down.



FIG. 98.—Smellie-Viet's manœuvre: method of delivery of the after-coming head.

(5) *Difficulty in after-coming head.* This is a common danger to the foetus. The usual causes are deflexion of the head, undiagnosed

disproportion between the head and pelvic brim, delivery through an imperfectly dilated and retracted cervix. A narrow sub-pubic arch often gives rise to difficulty in extracting the head.

In an uncomplicated breech delivery, Marshall-Burns technique is often successful. It is imperative that during breech extraction or assisted breech delivery the flexion of the head should be maintained. This can be helped if an assistant gives gentle fundal pressure during the process of delivery. The Mauriceau-Smellie-Viet technique described earlier is a very useful procedure in cases of difficulty. Forceps application to deliver the after-coming head is now a standard procedure under the circumstances. Piper's forceps is specially designed for this purpose, and is a most useful instrument.



FIG. 99—Delivery of the after-coming head: Smellie-Viet's.

Various manual methods of delivering the after-coming head have been described. All these methods even when judiciously employed are associated with varying degrees of trauma to the child which may at times be fatal. Sometimes such trauma even though not lethal may give rise to late sequelæ in the form of mental retardation. In present-day practice if simple methods fail forceps is employed. This is less traumatising than the many manual methods described.

Forceps to the after-coming head. To apply the forceps an assistant carries the body of the child forward towards the mother's abdomen and the operator introduces the blades, one on either side of the head, and then applies steady traction. In cases where the occiput is posterior, it may be advantageous to apply the forceps from above the child's body.

Perforation. If forceps fail nothing remains but to perforate through the sub-occiput or roof of the mouth and deliver the after-coming head.

A difficulty that may sometimes be experienced in the delivery of the after-coming head is its extraction in cases where the occiput is directed posteriorly. Such a complication should be extremely rare, particularly if the accoucheur has been in attendance from the beginning. If it happens, attempt at delivery may be made by gripping the shoulders with two fingers of one hand and pulling the baby first backwards so that the forehead is fixed against the posterior surface of the symphysis pubis and then the trunk is carried upwards on to the abdomen of the mother.



FIG. 100.—Delivery of the after-coming head when the occiput is posterior.

If there still be difficulty in the delivery, forceps may be applied. Deep tears of the perineum are inevitable, and it is preferable to perform a prophylactic episiotomy in such cases. Where delivery cannot be effected, craniotomy, as has been described above, is the only method of delivery available.

All these methods are not without danger to the fœtus. Fractures of the lower jaw and fracture-dislocation of the cervical vertebræ are not uncommon fœtal complications if these techniques are used without extreme caution. As a routine, they are not recommended.

(6) *Extended breech.* This should not be considered as a complication of breech presentation. In fact, of all varieties of podalic presentations, it has the best fœtal prognosis. Owing to the compactness of the presenting part it engages early in labour in the absence of any contractions of the pelvis or fœto-pelvic disproportion. Uterine inertia, premature rupture of the membranes and prolapse of the cord are less common than in a fully flexed breech. Spontaneous delivery with assistance to the after-coming head takes place in the absence of

any complicating factors. The only danger is impaction. It was customary in these cases to bring down a foot when cervical dilatation was sufficient—about $\frac{3}{5}$ —for the manœuvre. As this is associated with a higher foetal mortality it is not adopted as a routine except under special circumstances. For this purpose, under anæsthesia, the gloved hand is introduced into the vagina, the fingers are then guided along the posterior aspect of the thigh to the knee and gentle pressure exerted in the popliteal space. This will cause the leg to flex at the knee when the fingers are passed along the shin till it



FIG. 101.—Bringing down a foot in extended breech.



FIG. 102.—Finger traction in impacted breech.

reaches the foot. The foot is then grasped and brought down to the vulva. This procedure may be adopted when impaction is suspected. Delivery may then be left to natural efforts. Under no circumstances should the breech be extracted if the cervical dilatation is not complete.

(7) *Impacted breech.* Impaction of the breech occurs when the breech is extended. Such impaction may occur at the brim, cavity or outlet. The commonest cause of impaction is disproportion between the size of the breech and pelvis. If this is present at the brim, naturally it will not descend into the cavity. In the cavity, the impaction may be due to alterations of the capacity of the pelvis and also in shape. Thus a straight sacrum, converging side walls and narrow sub-pubic arch

may cause impaction in the cavity and outlet. The Android pelvis in particular is a very potent cause in the production of impaction. A thorough antenatal examination should rule out such variation in shape and size of the pelvis and if diagnosed the need for cæsarean section would arise. If, however, cases are seen in labour after some hours in the second stage and no marked abnormalities are present in the pelvis or foetus, vaginal delivery is usually undertaken.

If the impaction is in the cavity or at higher levels under deep anæsthesia an attempt should be made to disimpact the breech by gently dislodging it with the whole hand in the vagina after which the hand is passed up along the thighs to the knee. The fingers then flex the knee joint when the foot drops down. At this stage the obstetrician passes his hand over the shin to the foot, catches hold of it and brings it out. The process of extraction is now proceeded with.

If disimpaction is not possible and the arrest is high in midcavity and the baby is in good condition, delivery by cæsarean section is indicated.

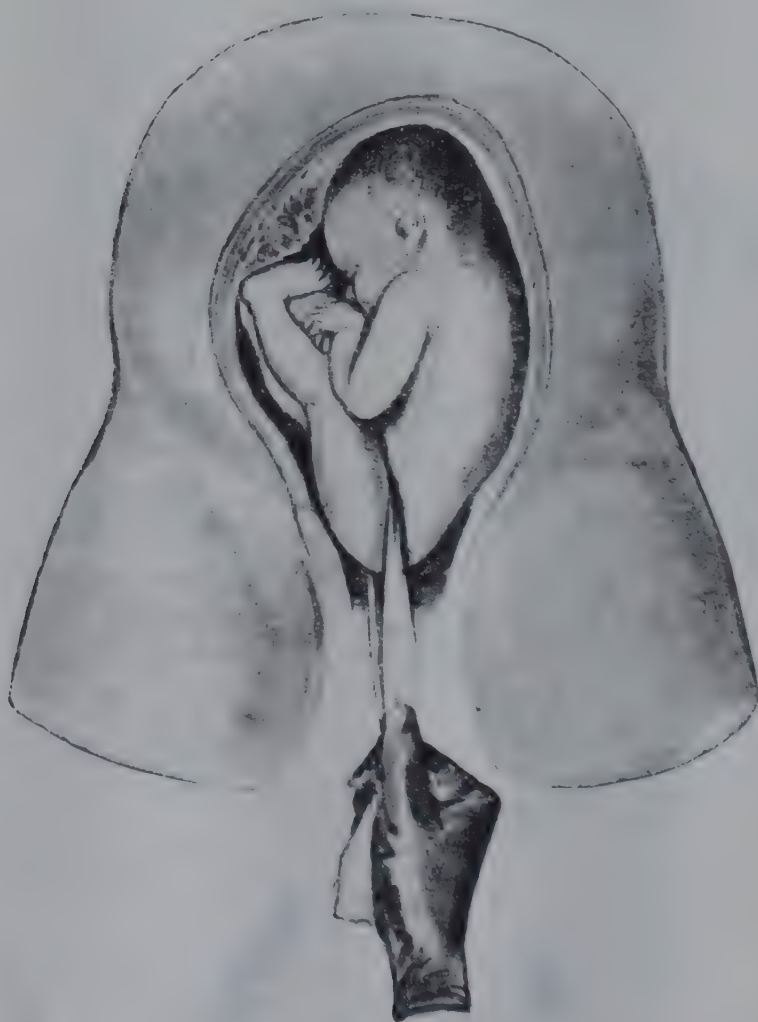


FIG. 103.—Fillet traction in impacted breech.

Impaction at the outlet is dealt with by episiotomy and traction with finger in the groin. Traction can also be applied to both groins

by fingers of the two hands, and often with success. *Fillet gauze traction*—after passing the fillet of gauze into a groin—is at times done. In dead babies the blunt hook can be used. It is passed round the groin taking care not to injure the bladder with its knob pointing away from the bladder. With steady traction the breech can be delivered. One should always be aware of the great dangers in using the hook—fracture of the femur and injury to the vessels in the groin. Hence it is not now used on living children.

(8) *Uterine inertia*. This is a common complication in breech delivery. Under the influence of sedatives and given enough time, the uterine action is often restored to normal and the labour proceeds. Sometimes the inertia persists. If it is associated with a large baby, or a contracted pelvis, cæsarean section is the line of treatment. With an adequate pelvis and an average sized child, if inertia supervenes with the breech in the cavity, the use of a controlled oxytocin drip— $2\frac{1}{2}$ units in 500 ml. of 5% glucose—given at a rate which produces normal uterine action is favoured. It often helps the breech to descend and be born vaginally with assistance.

The Place of Cæsarean Section. There has been a definite increase in the incidence of cæsarean section in breech deliveries which has improved foetal prognosis. We propose to discuss only the indications for cæsarean section for a primary breech presentation, that is, where there is no other ætiological factor like contracted pelvis, which indicate cæsarean section.

(1) It is now customary to consider resorting to cæsarean section when the baby is large, that is over eight pounds.

(2) If uterine inertia persists for some hours after rupture of the membranes, cæsarean section may be the better line of treatment. The question of stimulation by a controlled intravenous oxytocin drip may be thought of, if the pelvis is quite normal and the baby of average size. It is unwise to wait too long, to decide in the presence of inertia—not longer than 24 hours—before taking a final decision.

(3) Elderly primiparity and toxæmia usually point to cæsarean section.

(4) Non-engagement of the breech even late in labour after rupture of the membranes is better dealt with by cæsarean section as it is often due to disproportion between the pelvis of the mother and the breech.

(5) Prolapse of the cord when the cervix is only partially dilated and the foetus is in good condition is an indication for cæsarean section.

Foetal Mortality. The gross foetal mortality in breech deliveries is high but it is mostly due to complications. In uncomplicated breech

deliveries with skilled assistance and judicious employment of cæsarean section, the perinatal mortality is in the region of 5-6%. Of late, there has been a great increase in the incidence of cæsarean section in breech deliveries for curtailing foetal mortality—in some clinics the incidence of cæsarean section is as high as 20%. In the Madras Government Hospital for Women and Children the cæsarean section rate for breech presentation is 3% and the perinatal mortality for uncomplicated breech delivery is 7.5%. This includes patients brought late in labour as emergencies.

Foetal Injuries in Breech Deliveries. The foetus is liable to several injuries during the course of delivery. These include fractures of long bones, the lower jaw, fracture dislocation of cervical vertebræ, intracranial hæmorrhage and injury to the soft parts and nerve roots.

The extent of the injuries will depend upon the difficulties arising in the course of delivery and the particular method of delivery adopted to overcome them. Ordinarily where no disproportion is present and no complications are met with, foetal injuries are rare, if the case is properly conducted.

TRANSVERSE OR OBLIQUE LIE

IN a transverse or an oblique lie, the fœtus lies generally with the cēphalic pole in one or other of the iliac fossæ and the breech at the opposite end of an oblique diameter of the uterine ovoid. A true transverse lie, as such, does not occur in most instances, as the natural tendency is for the heavier part, the cephalic pole, to slip towards one of the iliac fossæ, while the breech passes in the opposite direction resulting in an oblique lie.

Incidence. Transverse or oblique lies are not infrequent. At the Women and Children's Hospital, Madras, there were 126 cases among 25,804 confinements—an incidence of 1 in 204. It is more frequent in multiparæ than in primiparæ and occurs oftener in premature labour than at term.

Ætiology. The causes of transverse lie are generally those which favour any malpresentation. They are contracted pelvis, placenta prævia, tumours complicating pregnancy, multiparity, hydramnios and uterine anomalies. Multiple pregnancy and prematurity also predispose to malpresentation.

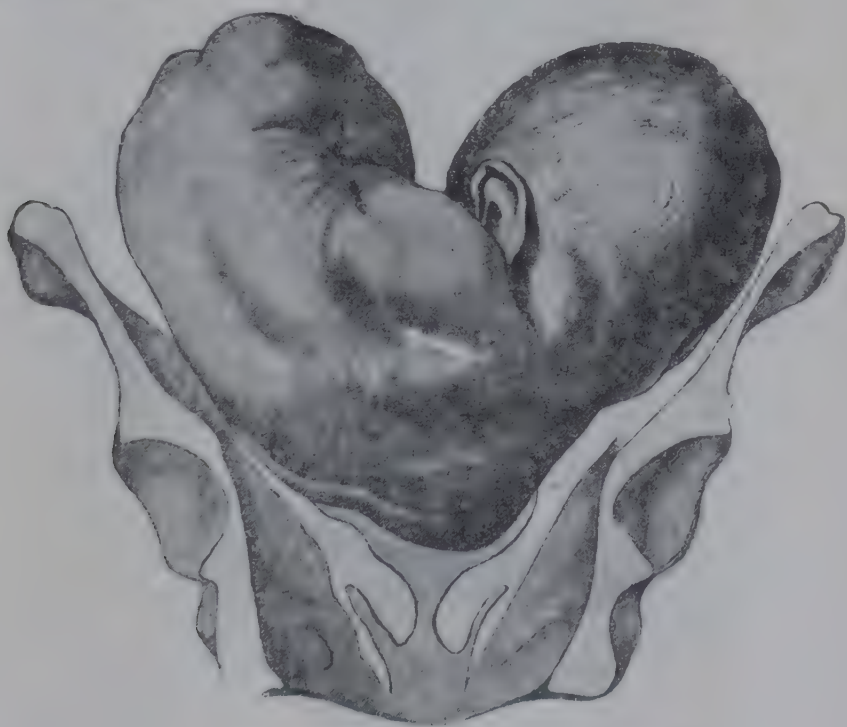


FIG. 104.—Left acromio-anterior.

Positions. When the fœtus lies obliquely, there are four positions that it can occupy. The head may be either in the left or right iliac

fossa, with the back in front or behind. When the head is in the left iliac fossa, with the back in front, the position is left dorso-anterior or L.D.A., the dorsum being taken as the denominator.

Another mode of nomenclature is to choose the acromion process as the denominator, in which case this position would be known as left acromio-anterior or L.A.A.

Diagnosis. The diagnosis of an oblique lie should not present much difficulty, if the case is seen antenatally or early in labour.

Inspection reveals that the uterus is stretched transversely and that the fundus is at a lower level than the period of pregnancy would warrant.

Abdominal palpation enables one to recognise that the head is in one or other of the iliac fossæ and the breech on the opposite side and at higher level. In some cases the breech may be in one or other of the iliac fossæ and the head on the opposite side near the fundus. Such cases tend to correct themselves spontaneously into a breech presentation when labour begins.

The foetal heart is generally heard on a level with the umbilicus, while in vertex presentations it is heard well below the umbilicus and in breech well above the umbilicus. Radiography confirms the diagnosis.

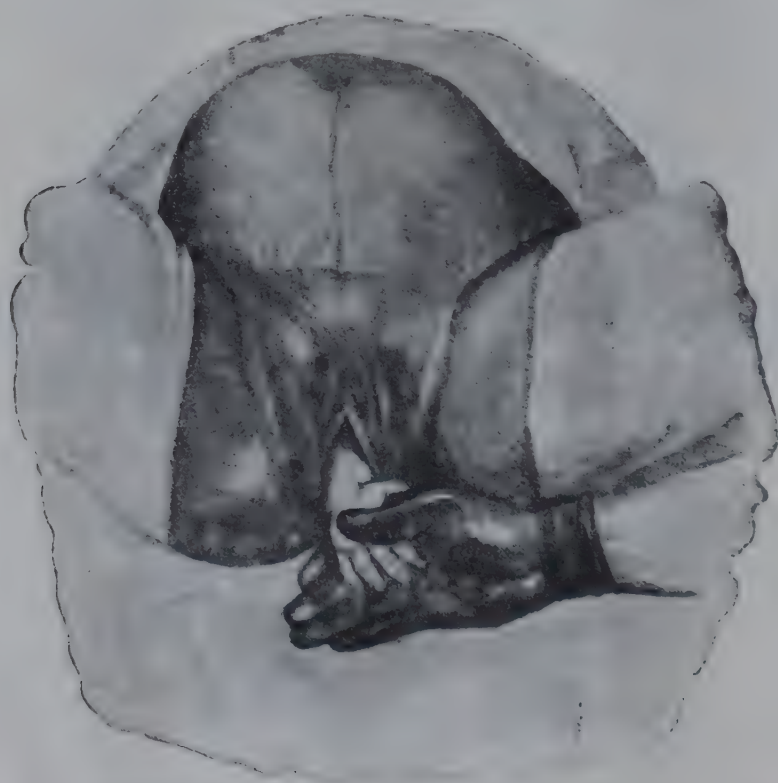


FIG. 105.—Oblique presentation with one hand prolapsed: method of recognising the side to which the hand belongs by shaking hands.

Vaginal Examination. When the patient is in labour, a vaginal examination is of great assistance. On a careful examination one

may feel the hand, elbow or the shoulder, and, if the fingers are passed up further, the side of the chest may be palpable. The shoulder can be recognised by palpating the acromion process, the scapula, the clavicle and axilla. On palpating further, the chest of the fœtus can be made out by noting the ribs which run parallel to each other. Occasionally, when the presenting part is still high up, it may be necessary to put the patient under anæsthesia and make a thorough examination to avoid any possible mistake. In some cases a fœtal hand may be prolapsed, but remember that it does not necessarily follow that if the hand is palpated or seen, it is a case of oblique lie, as in compound presentation, the head and hand may present together. Careful vaginal examination will obviate such mistakes. When the hand is prolapsed in the vagina, the side to which it belongs can be determined by trying to shake hands with it. A careless examination may sometimes result in a hand being mistaken for the foot.

Course of Labour. Supposing a woman with an oblique lie goes into labour, what may happen to her? Oblique lie presents insuperable difficulties to the delivery of the fœtus. In fact, with a normal pelvis and a normally developed fœtus at term, presenting by the shoulder spontaneous termination of labour is impossible without serious risks to the mother and child. There are a few exceptional ways in which an oblique lie may deliver itself; but they are so exceptional that they must never be counted upon. There are three ways in which an oblique lie may terminate spontaneously.

(a) Spontaneous rectification or version.

(b) Spontaneous evolution.

(c) Birth *Corpore Conduplicata*.

The term spontaneous rectification is applied to those cases where the correction results in a cephalic presentation, whereas if a breech presentation results, the term spontaneous version is used.

In *Spontaneous rectification* or *Version* the fœtus corrects itself by becoming either a vertex or a breech presentation. In such cases, when the uterus begins to contract at the onset of labour, the contractions may force the breech down towards the brim and the presentation is thus converted into a breech. Occasionally, rectification may occur when the head is in the iliac fossa, and the uterine contractions may be so directed as to push it towards the brim of the pelvis and thus allow it to engage. Spontaneous rectification or version may therefore occur, due to the activity of the uterus correcting minor degrees of oblique presentation. Such a possibility is more frequent in multiparæ than in primipara.

Spontaneous evolution. In such cases the oblique lie persists. Very often the hand may also be prolapsed, but after the hand has become prolapsed the trunk and breech are forced past the head, so that during delivery the shoulder appears first and is followed by the thorax, the buttocks, the opposite shoulder and finally the head. Such a termination generally occurs with unusually small children as in twins, or in premature births.

Birth corpore conduplicata. This is extremely rare. Unlike spontaneous evolution the foetal head and body enter the pelvis together and the child is born doubled up, the head and feet simultaneously coming together last. Such a termination is only possible when the child is macerated or very premature.

The above spontaneous terminations of shoulder presentation are exceptional, and in most cases the natural powers fail completely to

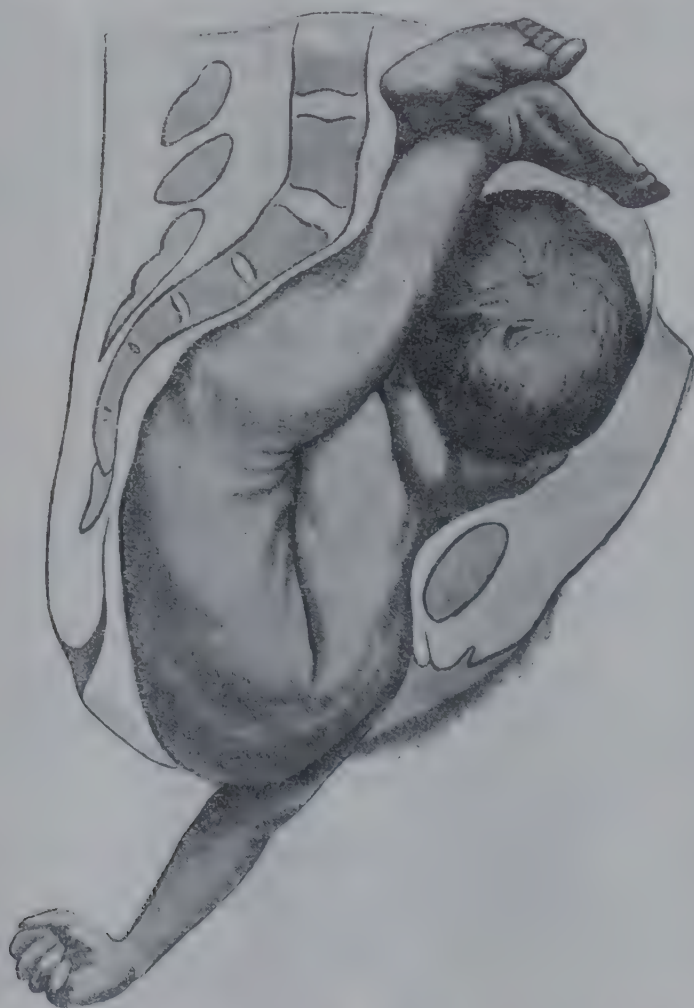


FIG. 106.—Shoulder presentation. *Birth corpore conduplicata.*

expel the foetus. Usually, when the woman goes into labour, the membranes rupture prematurely and a hand prolapses. With each pain the hand comes down more and more into the vagina and may present at the vulva and even the shoulder may be seen. The hand becomes swollen and œdematous and bluish. Continued uterine

action forces the fœtus to descend into and distend the lower uterine segment. The lower uterine segment is thus put on the stretch to accommodate the fœtus. As a result of the contraction of the upper segment and dilatation of the lower segment a line of demarcation between the two segments becomes demonstrable. This demarcation is the Bandl's ring or retraction ring which gradually rises higher and higher as the obstructed labour progresses. The ring may even rise to the level of the umbilicus. The height at which this ring is noted indicates the extent to which the stretching of the lower uterine segment has taken place and therefore the degree of thinning of its wall. Finally, a stage is reached when the lower uterine segment can stretch no more, and the uterus ruptures.



FIG. 107.—Neglected shoulder presentation.
Note the retraction ring.

When rupture takes place, the woman feels a momentary relief as uterine contractions cease; but the result of the rupture is that the fœtus and placenta may escape partially or wholly into the abdominal cavity. The woman goes into shock and collapse and if assistance is not available, a fatal termination is inevitable.

Prognosis. In those cases which are left to themselves without assistance the prognosis is grave, both to the mother and the child.

The prognosis for the child is always unfavourable, except when the case has been seen early in labour prior to rupture of the membranes and facilities are available for proper management. As there is no question of spontaneous delivery in these cases, the hazards of operative delivery to the mother and child are always present. In about 20% of cases prolapse of the cord occurs which again increases the foetal risks. The danger of rupture of the uterus is ever present in neglected cases.

Management: Antenatal. When an oblique lie is recognised in the later weeks of pregnancy, every effort should be made to correct it into a vertex presentation, by external version.

Management: In labour. Once again it is stressed that every attempt must be made to correct the presentation by external version in the antenatal period and also if possible to identify the ætiological factor. If neither of these be possible and the patient is seen early in labour, another attempt at conversion into vertex in a primi or vertex or breech in a multi by external version may be tried. If this also fails, the obstetrician has to make a quick decision regarding the line of management.

(1) In a primigravida, if a transverse lie persists with a normally sized child at term or early in labour, it is best to do a cæsarean section. In a multigravida with a good obstetric record vaginal delivery should be given a trial. When the cervix is sufficiently dilated internal podalic version is done, a foot is brought down and the rest of the labour left to natural efforts. Under no circumstances is breech extraction done with incomplete dilatation of the cervix. One has to accept a higher foetal mortality with this method.

(2) If a hand is found prolapsed in the vagina, the line of management will depend upon the degree of dilatation and effacement of the cervix. If the cervix is fully dilated and effaced and the membranes have ruptured only recently, the uterus acting normally, internal podalic version and extraction is done under anæsthesia, irrespective of the state of the child, whether alive or dead.

Should the prolapse of the hand be associated with only partially effaced and dilated cervix, and if the foetus is in good condition and the uterus is acting normally or is inert, there are two lines of treatment.

(a) Under anæsthesia do an internal podalic version, bring down a foot and leave the breech to be born at a later stage naturally or with assistance.

(b) If the baby is alive and in good condition, do a cæsarean section.

With the former method the fœtal mortality was very high (35-40%). Hence we are now in favour of doing cæsarean section, especially in primigravida. Where the fœtus is dead under the same conditions a foot is brought down by internal version and delivery at a later stage.

The Delayed Cases. In present-day practice, these cases should be rare. Here, as a result of neglected and prolonged labour, the uterus has gone into a state of tonic retraction and threatened rupture. The clinical picture is characteristic—the patient looks anxious and tired, tongue is dry, pulse rapid and she is in severe pain. The uterus is standing out prominently and across it at or below the level of the umbilicus a transverse groove is seen running across—Bandl's ring. This groove is the line of demarcation between retracted upper and stretched lower uterine segment which is never seen above the symphysis in normal labour. The round ligaments may be seen standing out like ropes on either side. The patient resents palpation of the uterus as it is tender. It is impossible to make out any fœtal parts owing to the extreme contraction and retraction. A hand is prolapsed out of the vulva as far as the arm or more. It is blue and œdematous. Fœtal heart is almost always absent. The cervix on vaginal examination is nearly always fully dilated.

The treatment in these cases would be to put the patient immediately under deep anæsthesia as the uterus is on the verge of rupture which may take place at any moment. Avoid internal podalic version. Delivery should be by decapitation which can be performed as the neck is within easy reach in these cases or by spondylotomy in cases where the arm is not prolapsed. The technique is described under operative obstetrics. After decapitation pull the prolapsed arm which helps to deliver the headless trunk and then deliver the head. After expulsion of the placenta it must be made a routine to explore the uterine cavity manually to find out if there is any rupture. If a rent is diagnosed no time should be lost in treating it.

Threatening rupture with only partially dilated cervix is better treated by cæsarean section.

The extended use of cæsarean section for this particular presentation has saved many babies and mothers from rupture of the uterus by injudicious internal podalic version. It is emphasized that presence of other complications like elderly primiparity, pre-eclamptic toxæmia, variation in shape and size of the pelvis and any other complicating factors are indications for elective cæsarean section.

When rupture of the uterus has occurred, the treatment is usually laparotomy and hysterectomy.

Lower segment caesarean section is the type of caesarean section usually preferred. In some cases, with prolapsed arm, it might be occasionally very difficult and hazardous to do the lower segment operation. Hence, at times, classical caesarean section will have to be performed under these conditions.

PRESENTATION AND PROLAPSE OF THE CORD : COMPOUND PRESENTATIONS

‘ **PRESENTATION** of the cord ’ is the condition where the cord lies in front of the presenting part before rupture of the membranes. Prolapse of the cord implies that the cord is in front of the presenting part after rupture of the membranes.

At the Women and Children’s Hospital, Madras, prolapse of the cord was noted in 126 cases out of 25,804 confinements, giving a proportion of 1 in 212.

Aetiology. Factors which prevent a proper fitting of the presenting part to the pelvic brim may cause prolapse of the cord when mem-

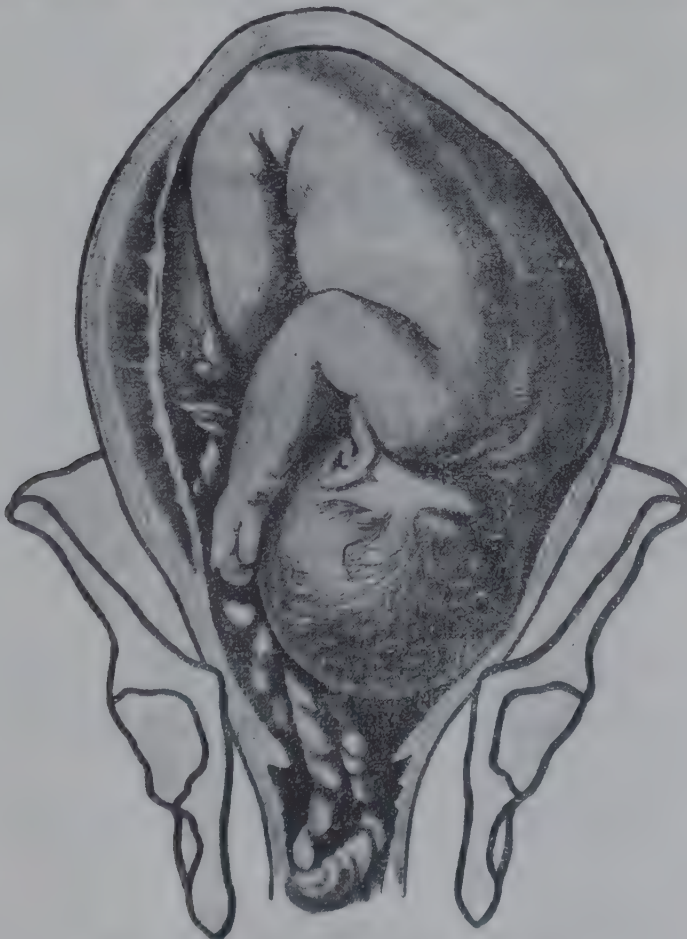


FIG. 108.—Prolapse of the cord.

branes rupture. These are usually contracted pelvis, malpresentations, placenta prævia, and tumours in the region of the lower uterine segment. In hydramnios when the membranes rupture there is a marked tendency

for cord to prolapse. An unduly long cord may occasionally prolapse. The normal length of the cord is 45-55 cms. Cases are on record where the cord measured as much as 90-100 cms. In battledore placenta where the cord is attached to the margin prolapse of the cord is more likely.

Diagnosis. The diagnosis of this condition is fairly simple and is made by a vaginal examination. In presentation of the cord the pulsations of the cord may frequently be felt through the intact membranes. When the cord has prolapsed a loop may be seen lying outside the vagina and the diagnosis is obvious ; but when it is still within the vagina or high up it may sometimes be mistaken for the intestines of the foetus which may occur in a case of *Exomphalos*. If the cord pulsates there is no likelihood of any mistake being made. Occasionally, during a uterine contraction the pulsations may cease but return when the contraction passes off. It is a wise precaution to auscultate for the foetal heart sounds if the pulsations are not easily felt by vaginal examination.

It is again stressed that in all cases of labour where the presenting part is not fixed at the brim of the pelvis, a vaginal examination is essential as soon as the membranes rupture, to see if prolapse of the cord has occurred. Irregularities in the rate of the foetal heart sounds during the first stage of labour indicate interference with the foetal circulation and the possibility of a funic presentation must be fully investigated.

Prognosis : Foetal. The chief danger of this condition is to the foetus. The foetal mortality is very high. The prognosis is worse when the presentation is cephalic than when it is pelvic.

Maternal. So far as the mother is concerned, in the absence of any complications, prolapse of the cord need not render the prognosis worse.

Treatment. The treatment to be adopted in any particular case of presentation or prolapse of the cord depends mainly on two factors.

(1) The ætiological factors responsible for it.

(2) Whether the child is alive or dead, i.e. whether the cord is pulsating or not.

Presentation of the Cord. In this condition the underlying cause should be ascertained. Where it is due to definite contraction of the pelvis and the consequent non-engagement of the presenting part, the treatment is naturally directed to deal with the contracted pelvis. In other cases the first object is to prevent rupture of the membranes so that the cord may not prolapse.

Postural Treatment. Attempts at correction may be made by postural methods. This consists in putting the patient in a posture where the fundus of the uterus is at a lower level than the lower uterine segment. The cord may then gravitate towards the fundus.

The postures adopted are :—

- (1) Knee-chest or knee-elbow position.
- (2) Trendelenburg position.
- (3) The elevated Sim's position.

When any of these three positions is adopted, the pelvis is elevated and the chest and upper abdomen lowered. After the cord has slipped away from the lower pole of the uterus the woman is made to lie on her back and the presenting part is pressed down into the brim of the pelvis and a tight abdominal binder applied. It is, however, necessary to watch the fœtal heart carefully from time to time, and if there be any irregularity to make a vaginal examination to ascertain whether the cord has once more slipped down.

In cases where the cervix is fully dilated, or nearly fully dilated, and the presenting part is not fixed, in multiparæ rupture of the membranes, and internal podalic version and delivery of the fœtus may be carried out.

Prolapse of the Cord. Two factors have to be emphasised :

(1) That when a cord has prolapsed the fœtus is in immediate and great danger.

(2) The longer the interval between the prolapse of the cord and the delivery of the baby, the greater the fœtal mortality. If delivery could be completed within half an hour of prolapse of the cord the fœtal mortality can be reduced to 10% or less and if it is more than half an hour it rises to nearly 40%. Hence in the management, early diagnosis plays an important part and routine vaginal examination is essential in cases with unengaged presenting part at the time of rupture of the membranes. Once the cord prolapses the first decision to be made is whether it is pulsating or not and it is necessary at the same time to determine the cervical dilatation. If the cord is strongly pulsating and the cervix is less than three-fourth dilated, immediate cæsarean section will offer the baby the best chance and while waiting for the operation the compression on the cord should be removed by displacing the presenting part by the postural methods or vaginally by lifting it out of the pelvis. If the cervix is fully dilated and conditions are favourable, an internal podalic version and extraction in vertex presentation or breech extraction in breech presentation should be carried out. In a primigravida cæsarean section is safer if the head is not engaged.

At times the cord could be pushed up above the presenting part and in vertex presentation a Willet's scalp traction forceps is applied to the vertex to allow engagement of the head and prevent prolapse of the cord. This method avoids a cæsarean section in a multigravida but one must be prepared to accept a foetal mortality of 30-40%. If the cord is not pulsating and the child is dead, no active measures are necessary. The only indication for interference will be maternal distress in labour. It is always to be borne in mind that the ætiological factor responsible will influence the line of management. In all cases immediate delivery with the least possible trauma to the mother and the child should be the aim if best results are to be obtained.

Compound Presentation

In this condition more than one part of the foetus presents at the brim of the pelvis at the time the patient goes into labour.

Varieties. The commoner forms are: (1) head and hand and (2) head and foot. More rarely the hand and foot may present

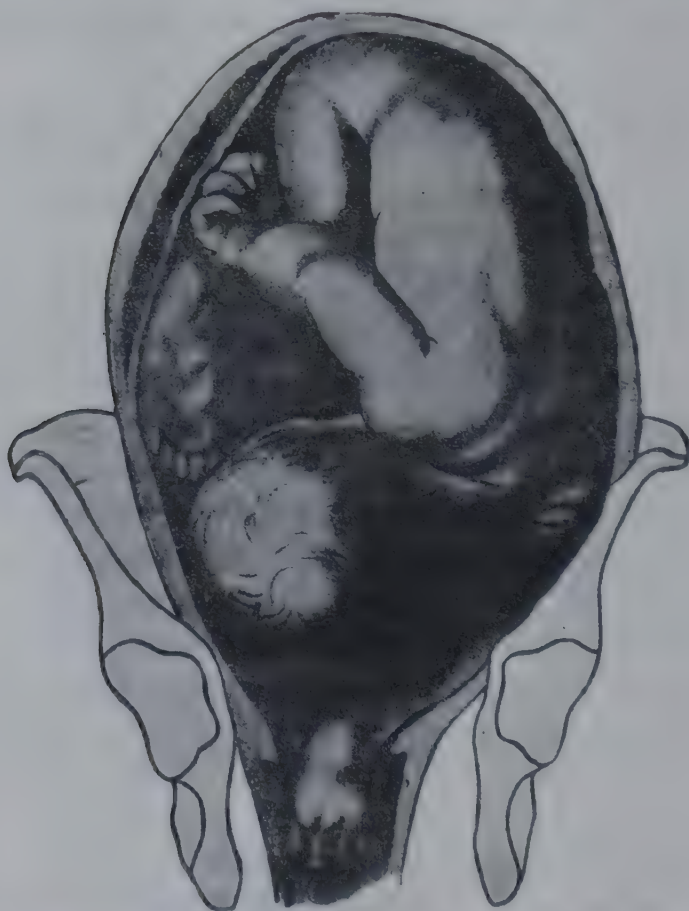
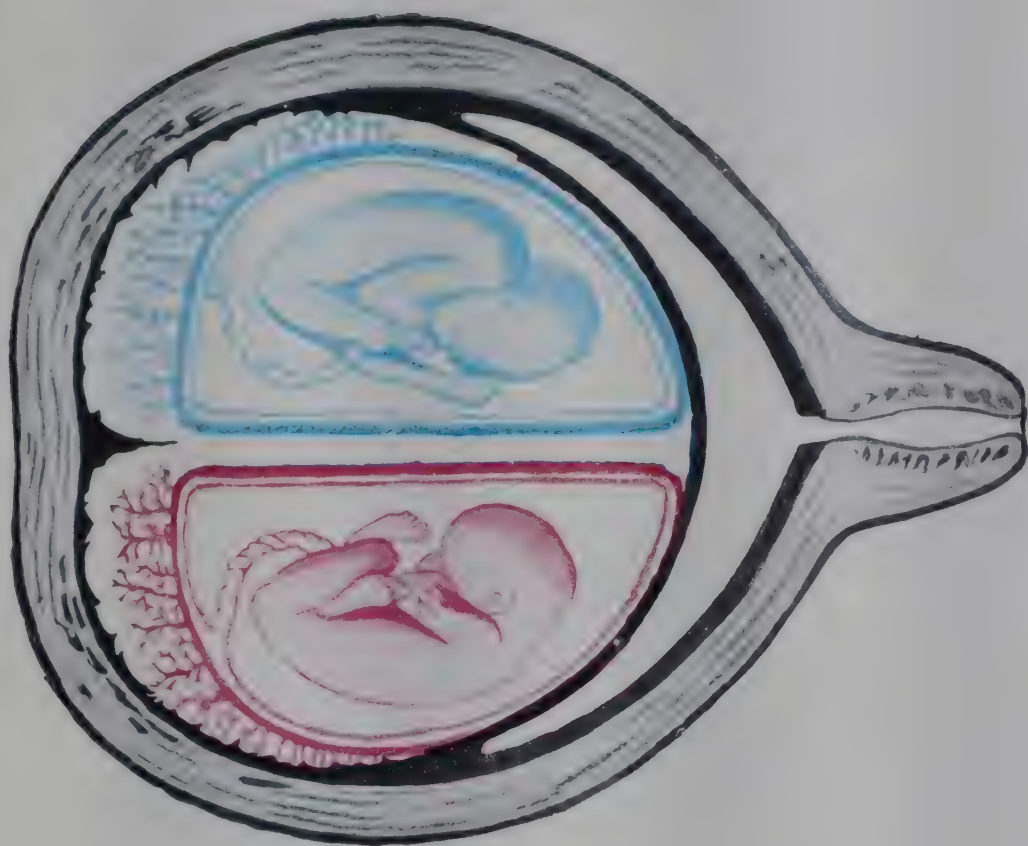
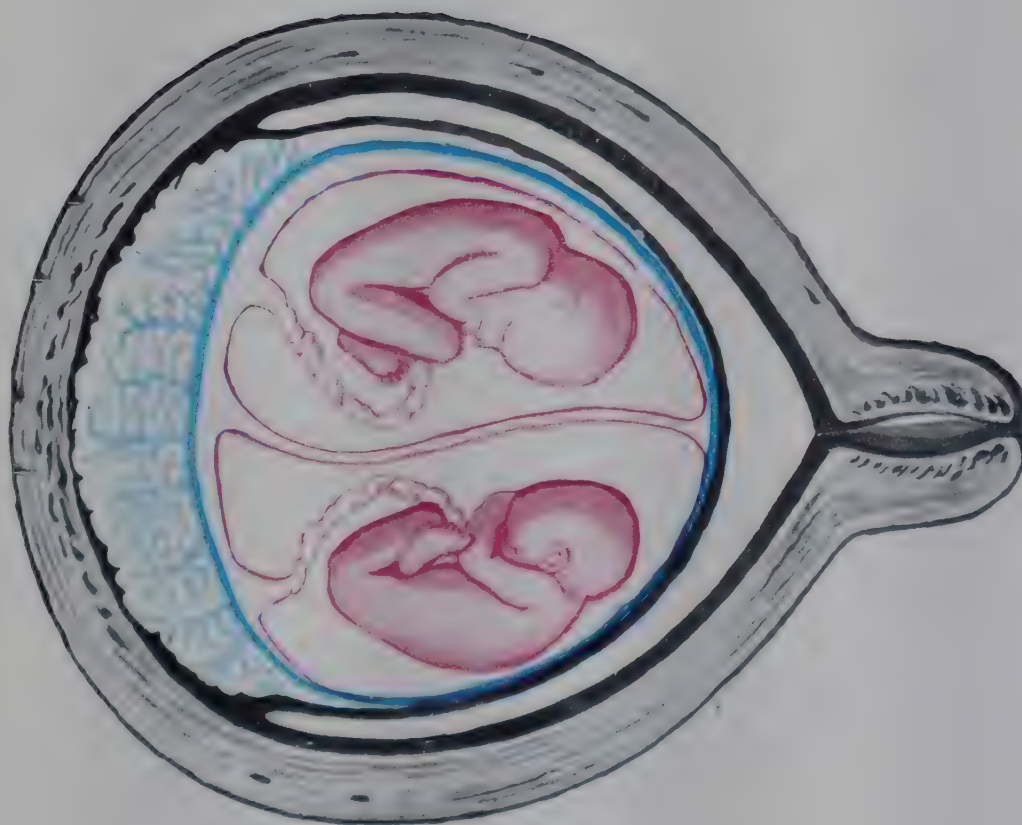


FIG. 109 —Compound presentation : head and hand.

together; and rarer still head, hand and foot, all three may present simultaneously.



B. Binovular.



A. Uniovular.

110a

FIG. xxx.—Twin pregnancy.

Aetiology. The causes of compound presentations are conditions that prevent complete filling and occlusion of the pelvic inlet by the presenting part, namely multiparity (through lax abdominal wall and a high head), pelvic contraction and small infants. Often however no causes are demonstrable.

Diagnosis. It is impossible to diagnose this condition by abdominal palpation. A skiagram may occasionally reveal the condition. A vaginal examination is the only method of diagnosis. It will reveal the presence of more than one foetal part.



FIG. 110.—Compound presentation : head and foot.

The cord may occasionally be found prolapsed along with any of the other presenting parts.

Treatment. In most cases the prolapsed part should be left alone since it interferes with labour only seldom. If the entire arm is prolapsed alongside the head replacement may be necessary if it is found that labour is not progressing. Under anæsthesia the hand should be replaced above the head which then should be brought into the pelvic cavity either by fundal pressure or by traction on the scalp with Willet's forceps. In primigravidæ with normally sized foetuses sometimes cæsarean section would be indicated in the interests of the child. If the foetal heart is inaudible the head may be perforated and delivery effected.

Head and Foot. This is a rare condition and in the majority of cases if the head is not actually engaged in the brim of the pelvis, the child may be extracted by traction on the prolapsed foot thus converting the presentation into a breech.

If the head has already engaged with the foot alongside, labour may be allowed to progress provided a careful watch is kept on the condition

of the uterus and the foetal heart. At any time when signs of foetal distress arise the head can be extracted with forceps.

If the child be dead and the head is engaged, craniotomy may be done and delivery completed.

The perinatal loss is high about 25-30% but most of it is due to prematurity.

Prolapse of the cord with compound presentation. The treatment in such cases is directed mainly to the condition of prolapse of the cord, irrespective of the presence of the compound presentation. The general principles to be borne in mind have been dealt with earlier in this chapter.

MULTIPLE PREGNANCY

MULTIPLE pregnancy means the simultaneous development of more than one fœtus in the uterus. In the human species it is usual for only one fœtus to develop during pregnancy, but sometimes two grow simultaneously; triplets, quadruplets, quintuplets and even sextuplets have been recorded.

Twin pregnancies are not infrequent. At the Women and Children's Hospital, Madras, 413 cases of twin pregnancy occurred in 25,804 confinements giving a proportion of 1 in 62. Triplets occurred in 5 cases and only one case of quadruplets was recorded among 54,000 deliveries. Cases of quintuplets and sextuplets are extremely rare.

Ætiology. The cause of twin pregnancy is not clear. There is no doubt that there is a hereditary predisposition which it is stated is more generally transmitted through the female, so that there are records of families where twin pregnancy has occurred in successive generations, although sometimes one generation may be missed.

Varieties. There are two varieties of twins commonly noted, namely, uniovular and binovular twins.

Uniovular twins result from the fertilisation of a single ovum, whereas Binovular twins are derived from separate ova. Uniovular twins are always of the same sex and resemble each other very closely. There is usually one common placenta one common chorionic membrane and two separate amnions. Single ovum twins are thus monochorionic and diamniotic. However though rare they may be monochorionic and monoamniotic i.e., one chorion and one amnion. This could be due to the fusion or atrophy of the amniotic partition or as it is now believed be due to late splitting of the fertilised ovum. Such division must occur between the seventh and thirteenth day of fœtal life for later splitting gives rise to conjoined twins. In binovular twins there are always two separate placentæ which are occasionally fused to each other, thus giving the appearance of a single one, but they are essentially separate and there is no inter-communication between their circulations. Each fœtus has got its own chorionic and amniotic sac i.e., dichorionic and diamniotic. The fœtuses may be of the same or of different sexes and they may not resemble each other.

Twins are usually smaller than the child of a single birth, but the combined weight of the two is greater than that of a single child. In most of the cases delivery is premature, probably due to the greater distension of the uterus caused by the plural pregnancy. In some cases the twins differ considerably in size, which may be due to relatively larger amount of blood supply passing to one fœtus at the expense of the other. This disproportion in the placental circulation may sometimes be so extreme that one fœtus monopolises practically the whole of the blood supply, and consequently the second twin dies. In such cases of intra-uterine death, one fœtus gradually becomes dried up and mummified. The pressure exerted by the other living and growing fœtus, so compresses and flattens the mummified one that it forms a fœtus papyraceous.

Presentations. Malpresentations are more frequent in plural births which also tend to be associated with hydramnios. In most of the instances the fœtuses present as both vertex or as vertex and breech. The combinations of the presentations, in their order of frequency, are :—

- | | |
|-----------------------|-------------------------|
| 1. Both vertex. | 4. Vertex and shoulder. |
| 2. Vertex and breech. | 5. Breech and shoulder. |
| 3. Both breech. | 6. Both shoulders. |

Course of Pregnancy. There is a greater tendency for some of the subjective symptoms to be exaggerated in cases of twin pregnancy. There may be increased incidence of nausea and vomiting. Owing to the unduly enlarged size of the uterus and the greater amount of pressure exerted on the abdominal viscera and surrounding structures, pressure symptoms may also manifest themselves in the course of pregnancy; thus œdema of the lower extremities, varicosity of the veins, constipation, palpitation and pain in the prechordial region are not infrequent. The patient may experience a greater amount of fatigue back-ache, indigestion, sleeplessness and difficulty in locomotion on account of the distension. All these symptoms will be exaggerated in cases where hydramnios co-exists with twin pregnancy. premature labour is more frequent in cases of twin pregnancy than in single births. There is a greater tendency for pre-eclamptic toxæmia to manifest itself in the earlier weeks of a twin pregnancy. Incidence of hydramnios is greater and acute hydramnios in the early months of pregnancy is commoner with uniovular twins.

Diagnosis. Inspection may reveal undue uterine distension suggesting the possibility of a twin pregnancy. In some cases the excessive amount of foetal movements felt by the patient all over on

either side of the abdomen and occasionally seen by the obstetrician on inspection should lead the latter to suspect a twin pregnancy.

Abdominal Palpation. Careful palpation may give reliable evidence of a twin pregnancy. To be definite, one must feel the cephalic poles of both fœtuses distinctly. Occasionally, it may be possible when the woman is in labour to make out the presence of one cephalic pole distinctly by vaginal examination and feel the other at the fundus by abdominal palpation.

Auscultation may be useful as a confirmatory sign. It would be unwise to rely on the auscultatory findings alone to make a diagnosis. If two independent observers listening simultaneously hear two fœtal hearts distinctly in two different areas, well separated from each other, the fœtal heart rates differing in frequency by at least ten beats, the possibility is that it is a case of twin pregnancy.

X-ray of the abdomen will confirm the diagnosis, particularly in those cases where hydramnios obscures both the palpatory and auscultatory signs.

Course of Labour. In an uncomplicated case of twin pregnancy, labour may not begin till full-term. In most cases, however, premature labour occurs. The first stage of labour is usually prolonged because of inefficient uterine contractions. Owing to the small size of the fœtuses, delivery is generally spontaneous.

The usual course of events is for the first child to be delivered spontaneously, after which the woman has a short period of rest. Generally, within half an hour, the pains once more increase in severity, the second bag of membranes ruptures and the second child is delivered, followed shortly afterwards by the delivery of the two placentæ. Occasionally, the interval between the delivery of the first child and the second may be prolonged and may last for a few hours, or very rarely for a whole day. Cases are on record where two or three days have elapsed between the delivery of the first child and that of the second, but these are exceptional. Equally rare is it to find that after the delivery of the first child the placenta of the first child follows. Yet another rare complication is that the placentæ of both twins may be expelled after the delivery of the first child, in which case the death of the second twin is inevitable, unless its delivery is effected immediately.

Prognosis : Maternal. The prognosis is not so favourable as in a single pregnancy because of the higher incidence of pre-eclamptic toxæmia and anæmia. Labour also is more likely to be prolonged and associated with weak uterine action increased operative inter-

ference and post-partum hæmorrhage. The foetal prognosis is particularly unfavourable. This is mainly due to the high incidence of premature labour and low birth weight of the infants. In addition, the increased incidence of pre-eclamptic toxæmia, anæmia and complications of labour also influence the foetal prognosis adversely. The second of twins has a higher perinatal mortality than the first.

The prognosis in cases of triplets and quadruplets is poor, as in most of these cases the labour is premature and the foetuses very small.

Management in pregnancy. To improve the foetal prognosis it is now considered essential that such patients be hospitalised and given complete rest in bed at least for the last six weeks of pregnancy and even earlier in the presence of complications. Such enforced rest may diminish the chances of premature labour and improve foetal birth weight. Antenatal care should be more frequent and more intense than when there is only a single foetus. Maternal anæmia and toxæmia and other complications if any should be promptly and vigorously treated. Hospitalisation is preferable to out-patient care under these conditions. Prolapse of the cord at the time of rupture of membranes should be looked for.

Management of labour. While in most cases of twin pregnancy, an attitude of watchful expectancy is all that is required during the management of labour, occasionally complications of a serious nature arise which require active interference.

In longitudinal lies, the first child should ordinarily be delivered spontaneously. Occasionally, where the first stage is prolonged it may be of some help to rupture the membranes; the uterine contractions increase in force due to the escape of the liquor amnii and the relief of over distension.

After the delivery of the first child the cord is ligated at two places and cut between. Then the uterus is palpated to determine the presentation and position of the second twin. Usually, this is easy to determine as at this stage the uterus is relaxed and the foetal parts can be readily made out. We have, however, noticed that a large interstitial fibroid has been mistaken for a second twin, and even intra-uterine manipulations attempted with a view to deliver the supposed twin. A little more care in abdominal palpation, combined with vaginal examination if necessary, should enable one to avoid such a mistake.

It is now realised that the longer the interval between the delivery of the twins the greater the perinatal mortality for the second twin. Hence, it is advisable to complete the delivery of the second twin within half an hour of the delivery of the first. In cases, where the second

twin is presenting transversely, an external cephalic or podalic version should be done and the membranes artificially ruptured, leaving labour to natural efforts. If this does not succeed, the patient is anæsthetised and internal podalic version performed and the second fœtus extracted.

If the second fœtus is presenting as vertex or breech the membranes should be ruptured soon after the delivery of the first twin. Usually, labour ends spontaneously. But if inertia sets in, a controlled intravenous drip of $2\frac{1}{2}$ units of oxytocin in 500 ml. of 5% glucose to stimulate normal uterine action will help delivery. If the head remains high delivery can be completed by internal podalic version and extraction under anæsthesia.

The management of the third stage of labour requires great attention. As a measure of precaution everything necessary for the treatment of post-partum hæmorrhage should be readily available. It is now routine to give 0.25 mgm. of Methergine intravenously at the time of delivery of the head of the second twin as it helps in diminishing post-partum hæmorrhage.



FIG. 111.—Interlocking of twins: the after-coming head of the first child obstructed by the descent of the head of the second.

Anomalies of the placenta may also be met with, particularly the form known as membranaceous placenta. In such cases expression may fail and manual removal of the placenta may be necessary.

Complications. Apart from such complications as prolongation of the stages of labour, prolapse of the cord and the possibility of premature separation of the placenta, interlocking of twins may occur. While this is a complication of a somewhat serious nature, it must be stated that it is exceedingly rare. The impression that locked twins is a common complication in the delivery of twin pregnancies is incorrect.

Several varieties of interlocking of twins may be met with. In 'interlocking' the delivery of one twin is impeded by the second twin obstructing its further progress at some portion of the birth canal. It may occur under the following circumstances :—

(1) *When both fœtuses are presenting by the cephalic pole.* The head of the second twin may attempt to descend into the pelvic cavity along with the head of the first resulting in a collision. It presses against the neck of the first and thus causes obstruction to further progress. This is more likely to occur when the cephalic pole of either fœtus is not sufficiently large to fill the brim of the pelvis.

(2) *When one child is presenting as a breech and the other as a vertex.* The chin of the after-coming head of the first fœtus may be caught by the chin of the second fœtus, or some portion of the cephalic pole of the second fœtus may try to enter the pelvis and cause obstruction to the progress of the after-coming head of the first child.



FIG. 112.—Interlocking of twins : chin to chin.

(3) *First child breech, second child transverse.* Here the after-coming head of the first may get caught by some portion of the trunk

of the second child lying transversely thus impeding the progress of the head of the first child.

The *diagnosis* of this condition is made by a careful internal examination whenever difficulty is experienced in the delivery of the first child. An anæsthetic may be necessary and the whole hand may have to be introduced into the uterus to make a thorough examination to determine the cause of the obstruction.

Treatment. (1) *Where dystocia is due to an attempt at engagement of heads in the pelvis.* The patient should be placed in the Trendelenberg position, and under a general anæsthetic, a whole hand should be introduced into the vagina and the second head pushed up out of the pelvis. The first fœtus may then be extracted with forceps and the second child allowed to be delivered spontaneously; but if immediate delivery is indicated it is carried out by version or by the application of forceps, depending upon the position of the head in relation to the pelvic cavity. If, however, the second head cannot be dislodged, forceps may be applied to the first head and delivery attempted by gentle traction. If this does not succeed, the condition does not warrant any further attempts to save the first child. Craniotomy should be performed and delivery of the first child effected followed by extraction of the second.



FIG. 112.—Interlocking of twins. Note that the after-coming head of the first is obstructed by the chest of the second.

In rare cases of interlocking, if both fœtuses are alive and near full-

term, it may be justifiable to perform a cæsarean section and thus save the twins.

(2) *Interlocking of the after-coming head of the first child with the fore-coming head of the second.* This is perhaps the more common form of interlocking met with. In such cases the head of the second child should be dislodged and pushed up. If this is found impossible, the only course open is decapitation of the first child, as it is partly born the pulsation of the cord would have ceased and then extraction of the second twin, followed by the expression of the decapitated head of the first child.

(3) *Interlocking in longitudinal and oblique presentation of twins.* Under deep anæsthesia, the second child should be pushed out of the way if possible and the first child extracted. Should this, however, be not possible and the fœtal hearts well heard, cæsarean section may occasionally be necessary. In other cases the only course open is to perform decapitation or craniotomy for the first child when the second twin is extracted after internal podalic version.

To summarise, the treatment of interlocking of twins consists in disentangling the interlock by pushing the obstructing portion of the second fœtus up and so permitting delivery of the first fœtus. Where this is not possible, the first child has generally to be sacrificed so that the second, which has a more favourable prognosis, can be delivered.

Lastly, another condition that may occasionally be mistaken for interlocking of twins is double monsters. They present difficulties in diagnosis and the treatment of this condition is dealt with in detail elsewhere.

DYSTOCIA DUE TO ANOMALIES OF
THE EXPULSIVE FORCES

To understand the anomalies of the expulsive forces it is necessary at the start to study the characteristics of and factors influencing the normal uterine action in labour. In the early weeks of pregnancy the uterus is quiescent; but as the pregnancy progresses contractions become manifest. These contractions are painless, intermittent, come on at long intervals, last only for a short time and are not followed by retraction or accompanied by dilatation of the cervix nor descent of the presenting part. Nearer term, these contractions become more frequent until at term they are converted into the true labour pains at the onset of labour. The characteristics of true labour pains are that they are painful, intermittent, occur with increasing frequency and are associated with dilatation of the cervix and descent of the fœtus. The nature of these contractions have been studied in detail by tocography. These studies have shown that in normal progressive labour the contractions of the fundus rise quickly to a maximum and are both strong and sustained. The middle zone of the uterus contracts simultaneously but less intensely and for a shorter time while the lower segment remains inactive and in low tone. According to Reynolds, 'cervical dilatation is the result of a gradient of diminishing physiological activity from the fundus to the lower uterine segment'. The most efficient uterus will therefore be one showing moderately low tonus and strong regular contractions.

The 'pace makers' of the uterus are located at the site of the entrance of the fallopian tubes. Normally a wave of contraction spreads from the two tubes over the fundus and down towards the cervix involving synchronous contraction of the successive areas of uterine muscles. From the central wave of contraction subsidiary waves spread out laterally till the whole uterus is in a state of contraction. Since each half of the uterus is developed separately from separate mullerian ducts with its own autonomic nerve supply, co-ordination of the whole process is very necessary; else irregular contractions will develop—each half contracting on its own. A very important feature is a balance of action between the upper and lower uterine segments—a feature termed polarity—whereby when the upper segment contracts the lower segment dilates. It is very necessary for normal labour that there should not only be the co-ordination of contractions but also diminution of tone in the different areas of the uterus.

Factors influencing uterine action in labour. The uterus is under both hormonal and nervous control. The hormones controlling uterine action are Œstrogen, Progesterone and Pituitrin. Œstrogens increase the frequency and amplitude of the uterine contractions. They also sensitise the uterus to the action of pituitrin. Progesterone was originally thought to be inhibitory; but it is now known to produce contractions of greater amplitude but of lesser frequency. Pituitrin is a powerful oxytocic. The presence of œstrogens is of prime necessity for uterine contraction for in its absence nothing can make the uterus contract.

The nervous mechanism which controls uterine action is still not well understood. There is a rich sympathetic (adrenergic) supply to the uterus which travels *via* the hypogastric plexus (Presacral nerve). The motor fibres of these nerves are largely inhibitory as far as labour is concerned since stimulation of these nerves causes contractions or spasm of the circular muscle fibres and affect the lower segment mainly. These nerves have their roots from the sixth dorsal to the third lumbar sympathetic ganglia. The uterus is also innervated through the parasympathetics. From the sacral plexus at the level of the third sacral vertebra the hypogastric plexus receives the parasympathetic fibres known as the *nervi erigentes* arising from the 2nd, 3rd and 4th sacral nerve roots. These fibres unlike the sympathetic are cholinergic. They are really motor in function since stimulation of these fibres causes contraction of the muscles of the upper uterine segment. According to this concept, the parasympathetics bring about the evacuation of the uterus while the sympathetics try to prevent it. Good uterine action depends on a proper balance not only between these two, but also on the balance of hormonal factors controlling the uterus. Various factors may therefore upset normal uterine action—factors which may be either developmental or acquired. The uterine action may be affected either through a nervous mechanism or a hormonal or by both.

The Pain of Labour. As mentioned before, the contractions during pregnancy are painless, while the contractions of labour are painful. The present view is that the pain in uterine contraction is due to ischæmia of the muscle allowing the accumulation of metabolites in the muscle. This ischæmia of the uterine muscle is due to high tone, marked retraction or strong prolonged contractions. The stretching of the lower uterine segment and the cervix gives rise to pain referred to the small of the back, *i.e.*, low back pain. The more the resistance offered by the lower uterine segment and the cervix to dilatation, the greater will be the degree of low back pain. The pain due to contraction of the fundus is usually situated over the abdomen and referred to the iliac regions also.

During labour all grades and variations of normal uterine action may occur leading to abnormalities in uterine action which upset the course and progress of labour. The more common anomalies of the uterine forces may be classified as shown below :—

I. *Unduly strong uterine contractions or the over-efficient uterus.*

These may result in :

- (a) Precipitate labour.
- (b) Tonic contraction of the uterus.

II. *Inefficient uterine contractions or the inefficient uterus.*

There may be two kinds in this type of contractions :

- (a) Hypotonic inertia—true inertia.
- (b) Inco-ordinate uterine action.

Precipitate labour. Labour is said to be precipitate when it terminates in a disproportionately shorter time than that taken on an average either by a primipara or a multipara.

The *ætiological factors* concerned in this condition are not easily determined. It occurs more frequently in multiparæ than in primiparæ, and is probably due to the fact that the soft parts are relaxed and the passages, including the patulous external cervical os, are in a way prepared by previous deliveries. It is more likely to occur in women with justomajor pelvis and a fœtus of normal size or in premature labours. Precipitate labour may occur in women with cardiac lesion and in those with severe anæmia. Occasionally, it may also occur in complications such as pneumonia during the course of pregnancy. It is not possible to anticipate this course of events except in those rare cases where a previous history suggests the possibility of precipitate labour occurring again.

Complications. Lacerations of the cervix, vaginal walls and of the perineum may occur. The chances of post-partum hæmorrhage are greater. In some cases inversion of the uterus may take place. Because of lacerations and the impossibility of making adequate antiseptic preparations for delivery, puerperal sepsis is more likely to develop.

Fœtal complications also arise. The rapidity with which the fœtus is expelled may cause trauma with intracranial hæmorrhage and possibly asphyxia. Occasionally, the fœtus may be expelled when the patient is in a standing posture and thus sustain serious injuries, or the cord may snap and hæmorrhage take place before assistance is available.

Prognosis : *Maternal.* The risks are greater in view of the complications, such as tears of the cervix, vagina and perineum, post-partum hæmorrhage and acute inversion of the uterus.

Fætal. Asphyxia and trauma increase the fœtal risks.

Treatment. The condition is hardly ever recognised until it has occurred. In cases with a previous history, precautions might be taken to see that the patient is placed in bed and assistance is available as soon as the first signs of labour appear. In such cases, it may be desirable to give an anæsthetic to prevent the strong uterine contractions beginning at too early a stage. After delivery the patient is carefully examined for any tears, which if present are sutured with due antiseptic precautions.

The third stage of labour must be carefully conducted.

Tonic Contraction of the Uterus. In this condition the uterus is in a state of continuous contraction and retraction so that there is no relaxation and no rhythmic action of the uterine musculature. The condition generally develops in those cases where there is some insuperable obstruction to delivery. The upper uterine segment begins to contract and retract, pushing the fœtus down, while the lower uterine segment expands and dilates thus accommodating a portion of the fœtus as it is being forced down. In the normal course of events, long before the lower uterine segment stretches to any dangerous extent, the fœtus passes through the pelvic canal and is born. But should an obstruction arise in the birth canal the increasing contractions of the upper uterine segment fail to expel the fœtus, and in such cases the uterus may pass into a stage of tonic contraction, which later leads to uterine exhaustion or rupture of the uterus. With each contraction the upper and the lower segments of the uterus become more markedly differentiated due to the retraction of the muscular fibres of the upper uterine segment and the stretching of the muscular fibres of the lower uterine segment. The muscular wall of the upper uterine segment thus becomes thicker and thicker, while the muscular wall of the lower segment becomes thinner and thinner. The demarcation between the upper and lower uterine segments becomes very prominent and a well defined ridge, known as a *retraction ring*, or *Bandl's ring*, may be made out by abdominal palpation, in cases of prolonged labour. At times the round ligaments may stand out as tense cords on either side.

Ætiology. The causes of tonic contraction are obvious. In most cases it occurs in obstructed labour, the uterus acting strongly in an attempt to overcome the obstruction.

Administration of certain oxytocic drugs, such as ergot or occasionally pituitary extract, if given in unsuitable doses or without proper indications, may produce tonic contraction.

Signs and Symptoms : *General.* The mother has an anxious expression, is restless, complains of severe and continuous abdominal pain ; the pulse is rapid, temperature elevated, tongue dry, sores may collect round the lips and gums, and cold clammy sweats break out. Occasionally nausea and vomiting may also be present.

Local Signs. These are referable to the uterus and vagina. On abdominal palpation the abdomen will be found to be tender, the uterus is very hard, the round ligaments prominent ; a definite ring, Bandl's ring or retraction ring may be present, running obliquely or transversely across the uterus, showing the demarcation between the lower and upper uterine segments. Because of the hard uterus the fœtal parts cannot be defined. The fœtal heart sounds cannot be heard distinctly on auscultation ; indeed they are frequently absent, as the child is dead.

On vaginal examination the vagina is found to be dry and warm ; the presenting part may be jammed in some portion of the pelvic canal ; a large caput succedaneum may be present, obscuring landmarks on the presenting part, the cervix is œdematous and there may be œdema of the vagina and perineum.

Clinical Course. When the uterus is in a state of tonic contraction, if delivery is not completed early, it will result in rupture of the uterus involving certain death of the fœtus and grave risks to the mother.

Other incidental risks are that the continued and prolonged pressure of the presenting part on the birth canal may lead to necrosis, followed later by sloughing and fistula formation. Puerperal infection is also common.

Diagnosis. The general condition of the patient, the abdominal tenderness, the hard contracted uterus with the prominent round ligaments, presence of Bandl's ring and the vaginal signs enumerated above, complete a picture which ordinarily enables one to diagnose it with ease.

Prognosis. In the absence of proper treatment, rupture of the uterus is the greatest hazard the patient has to face. After delivery, post-partum hæmorrhage and puerperal infection may enhance the risks. Fistula formation may be a late sequelæ.

Fœtal. The fœtal prognosis is very grave. In most of the cases the fœtus dies of anoxia due to direct compression of the placenta by the uterus after the liquor amnii has all drained away.

Treatment : Prophylaxis. This consists in a careful examination of the case both antenatally and early in labour, correcting any mal-presentations or malpositions and treating the case with due regard to such factors as are likely to cause obstruction during the course of delivery. Never give ergot in the course of labour before the fœtus has been expelled. Oxytocin should be given with great care. The indications and contra-indications for the use of this drug are dealt with separately.

Curative. When a case of tonic contraction of the uterus is met with, the patient should be given a dose of morphia ($\frac{1}{4}$ grain) and put under anæsthesia, while getting everything ready for immediate delivery. No intra-uterine manipulation such as version should be attempted. Immediate steps should be taken to deliver the fœtus in the most conservative manner, particularly in view of the fact that in most cases the fœtus is already dead. Craniotomy, decapitation, spondylotomy, embryotomy are some of the measures that may be needed to deliver the dead fœtus, depending, of course, upon the presentation and position. Occasionally, cæsarean section may have to be done in the interest of the mother even though the baby may be dead.

Uterine Inertia. It was customary to classify uterine inertia into primary and secondary—primary where pains are weak from the onset of labour and secondary where the uterus is in a state of exhaustion after having acted strongly for a time. Tocographic studies of uterine contractions and uterine muscle tone in different areas and clinical observations have now demonstrated that these terms are better avoided.

The inefficient uterus may be due to :

- I. Hypotonic inertia—true inertia.
- II. Inco-ordinate uterine action.

Ætiological Factors. Inco-ordinate uterine action is more often seen in elderly primigravidæ and rarely in multiparæ. It is said to be more common in the heavily built, stocky, relatively infertile women in whom the dystocia dystrophy syndrome also is more common.

The part played by anxiety and nervousness in causing inco-ordinate uterine action is well-known. A state of nervous tension may cause

high tonicity and resistance in the lower segment and cervix. 'A tense woman—a tense cervix.' This increased tone may be produced by an excess adrenaline secreted under emotional stress or may be the result of sympathetic over-activity.

Malpresentations. Occipito-posterior positions and other malpresentations are often seen in cases of inco-ordinate uterine action. Malposition of the foetal head and malpresentations may modify uterine action through insufficient stimulation of the nerve plexus in the region of the lower uterine segment.

Cephalopelvic disproportion is often associated with disordered uterine action, and as in malpresentations it may be due to insufficient stimulation. Overdistension of the uterus as in hydramnios and twin pregnancy and developmental defects of the uterus also may cause disordered uterine action. In the latter the type and severity of the disorder will depend upon the type and degree of developmental anomaly.

General Principles of Management. It is necessary in the first instance to exclude mechanical causes like malpresentations and disproportion. These factors affect the treatment. Where such factors are evident the management is necessarily directed towards its correction. The general care of the patient is very important. Regular attention to the bladder keeping up her fluid balance, relieving her fears and anxiety by proper explanations and suggestions and sedation and thus ensuring a calm mind will go a long way in the successful management of these cases. The most important factor is the determination of the type of disordered uterine action which can be done only by carefully watching the patient. On this will depend the institution of specific treatment for the disorder.

Hypotonic Inertia. In this condition the contractions of the uterus are feeble right from the beginning of labour. The amplitude of each contraction is very small and the frequency is also diminished. On palpation of the uterus even at the height of a contraction the uterus hardly hardens under the palpating hand. As a result, the labour is very prolonged. Such hypotonic inertia is not very common. The ætiological factors concerned are not very clear. It is possible that developmental defects of the uterus and hormonal imbalance may play their part. Ordinarily, no great harm is done to the mother or foetus by this type of inertia. The mother is not exhausted nor is the foetus endangered. But if the membranes rupture prematurely and labour is very prolonged, intrapartum infection may set in which will jeopardise the foetus and increase the risks to the mother.

Treatment. General supporting treatment is essential in all cases of prolonged labour. The principles mentioned under general management must be adopted. Hypotonic inertia is an ideal indication for the use of oxytocin in labour. In the absence of malpresentation and cephalo-pelvic in proportion, Oxytocin is given as an intravenous slow drip— $2\frac{1}{2}$ units in 500 ml. of 5% glucose. The drip is run in at a rate which produces normal uterine activity. The advantage of giving the oxytocin as an intravenous drip is that uterine activity can be controlled by regulating the flow of the drip. It should be administered only under medical supervision. The foetal heart rate must be carefully watched frequently during the administration of the drip and at the earliest sign of foetal distress it must be stopped. Syntocinon is a synthetic oxytocin and is now employed in place of pituitrin. Most of the cases of hypotonic inertia respond to this line of management. It may be necessary to repeat the drip on two or more occasions. Seldom is it necessary to use more than 10 units in 24 hours. A majority of cases can be delivered safely *per vaginam*. There may occasionally arise instances where after rupture of membranes and oxytocin drip uterine contractions prove ineffective. In much cases after a reasonable interval—not more than 48 hours from the onset of labour—cæsarean section may have to be performed.

Inco-ordinate uterine action. In this type the uterine contractions are usually irregular. The uterine muscle tone is higher. When it reaches above 25 mm. of Hg. pain is frequently experienced. The normal resting tone of the uterus is about 5 mm. of Hg. but with inco-ordinate action the resting tone rises to very high levels—20-30 mm. of Hg.

Clinical Features. The patient complains of severe colicky pain, hypogastric in distribution. The pain precedes and outlasts the palpable uterine contraction. In between pains, the uterine tone is high which is evident on palpation when no proper relaxation is found. Associated with this type of pain the patient complains of frequency of micturition, she begins to bear down as at the end of the second stage even though the head is at the brim and often complains of tenesmus. There is at times associated dilatation of the stomach and the descending and transverse colon. All these are typical features of sympathetic over-activity. Cervical dilatation proceeds slowly. In some low back ache and pain shooting down the legs are more prominent. These indicate resistance to dilatation. The patient is anxious and distressed which makes the inco-ordination worse. Labour is prolonged and all the complications of prolonged labour follow.

Treatment of inco-ordinate uterine action. The principles mentioned under general management should be followed. Stimula-

tion of the uterus by oxytocin is best avoided in these cases. Sedatives on the other hand must be given to allay the sympathetic overactivity. Morphia $\frac{1}{4}$ grain, Pethidine 100 mgms. with or without Hyoscine $\frac{1}{100}$ gr. are all useful. These sedatives may have to be repeated after three or four hours depending on the response. Adequate amount of fluids should be given to the patient, if necessary, intravenously to keep up the fluid balance. If the membranes have ruptured prematurely prophylactic antibiotic therapy should be instituted. With this line of treatment normal uterine action may be established after some hours, and labour progresses to its natural termination. When the cervix is fully dilated and the head engaged, labour may be terminated by forceps. Occasionally, if in spite of sedatives, the inco-ordination persists and labour makes no progress, cæsarean section may have to be done to save the child. This is more so if labour has made no progress even after several hours after rupture of the membranes. Complications such as elderly primiparity, disproportion or malpresentation when found in association with inco-ordinate uterine action may necessitate cæsarean section.

Fœtal and maternal mortality and morbidity. Fœtal mortality in cases of inco-ordinate uterine action is certainly higher than in cases where the uterine action is normal. If labour is prolonged beyond 24-48 hours after rupture of the membranes the fœtal mortality is doubled and after 72 hours it is almost trebled. Hence much depends on the response to treatment. It is because of this realisation of the influence of the time factor after rupture of the membranes on the fœtal mortality that at present the use of cæsarean section has been extended to these types of inco-ordinate uterine action. This extended use of cæsarean section has definitely helped to reduce the fœtal mortality. Neonatal pneumonia as a result of intrapartum infection of the fœtus is another danger if labour is unduly prolonged, and it accounts for a good proportion of neonatal deaths. Hence the necessity for prophylactic use of anti-biotics in labour. While maternal mortality may not be very adversely affected, the morbidity is enhanced. It is however surprising to find that inco-ordinate uterine action seldom repeats itself in a second labour.

Irregular contractions of the uterus : *Contraction ring and hour-glass spasm.* By the term 'contraction ring' is meant a definitely localised area of tetanic contraction confined to a segment of circular muscle fibres in the uterus. It is also called 'constriction ring' by some. It may form at any part of the uterus and in any stage of labour. When this ring forms in the third stage of labour it is spoken of as an 'hour-glass spasm' or contraction.

It is important to differentiate between the contraction ring and the retraction ring or Bandl's ring. It has already been stated that the

retraction ring begins as a physiological phenomenon, inasmuch as it is merely the demarcation between the upper and lower uterine segments and becomes more prominent in the second stage of labour. Its pathological significance develops only when it becomes clinically obvious on abdominal inspection and palpation at a high level above the symphysis pubis. A retraction ring, therefore, forms in the second stage of labour. A contraction ring, on the other hand, is not physiological and may occur in the first or second or third stage of labour. It is not necessarily associated with any obstruction to labour. The contraction ring may be around a part, often a small part, of the foetus such as the neck or the breech, or occasionally a limb; or it may be entirely dissociated from any portion of the foetus and occur below the level of the foetus altogether.

Causes. The causes of contraction ring formation are not clear. It could be considered as a result of inco-ordinate uterine action. It is probably due to some nervous factor which causes an abnormal irritability of the uterine musculature. It may result from the injudicious use of oxytocic drugs especially ergot.

Symptoms. Very few symptoms manifest themselves; in fact, the general condition of the patient does not indicate that a contraction ring has formed; nor can the ring be recognised by abdominal palpation. It is only on making a thorough internal examination in cases of prolonged labour without any obvious cause or usually following an unsuccessful attempt at delivery, that the presence of a contraction ring is diagnosed.

Diagnosis. The only certain way to diagnose a contraction ring is to feel it by vaginal or intra-uterine examination.

A very significant suggestive sign of the presence of a contraction ring which can be made out on vaginal examination is that, during a uterine contraction, the cervix does not become stretched but hangs loose; it may also be noted that during a contraction the presenting part can be easily displaced by the fingers in the vagina. Retraction ring found in cases of obstructed labour presents characteristic clinical signs and symptoms, described earlier, that it seldom gives rise to difficulty in differentiating it from a contraction ring.

Prognosis. Once a contraction ring has formed it shows no tendency to relax, and it presents one of the most difficult problems in obstetrics.

The maternal prognosis is serious as the condition causes severe dystocia and delivery presents unusual difficulties.

The fœtal prognosis is very bad. Over 80 per cent of the babies die.

Treatment. Various antispasmodic drugs have been tried in an attempt to relax the ring. Amyl nitrate inhalation, morphia, adrenaline, magnesium sulphate injections and deep chloroform anæsthesia were the methods employed. These may be useful when the spasm is mild and partial. Once a contraction ring has fully formed and is diagnosed after intra-uterine examination, the safest and best way to deliver is by cæsarean section as the ring seldom relaxes. Even if the child is dead, cæsarean section is indicated in the interest of the mother. Drugs are valueless and attempts at vaginal delivery are hazardous to the mother and child, if the latter is alive. In performing a cæsarean section a lower segment section with a vertical incision is preferable, as the upper end of the incision can be made to cut the ring.

Cervical Dystocia

Non-dilatation or achalasia of the cervix may be due to functional or organic causes. Cervical rigidity and non-dilatation for which no organic cause can be found is, like inco-ordinate uterine action, seen more often in primigravidæ, especially elderly primigravidæ. Histologically, these non-dilating cervixes do not reveal any abnormality in structure to account for their abnormal behaviour. Non-dilatation is also seen in association with malpresentations and disproportion.

The dystocia in these cases is usually at the external os, the whole cervical canal usually being taken up and often thinned out, the external os however remaining insufficiently dilated or even closed at times. Cases have been recorded where the babies have been born with a complete rim of the cervix attached to the scalp—circular avulsion.

Primary rigidity of the cervix never occurs in women who have had a previous vaginal delivery. At times a congenital hypertrophic elongation of the cervix may complicate the pregnancy. This muscular cervix seldom dilates in labour, and if unaided, the labour may result in rupture of the uterus.

Treatment. The treatment is on the same lines as for inco-ordinate uterine action discussed above. Sedatives for allaying the sympathetic over-activity, correction of malpresentations, maintaining the

patient's strength and fluid balance, antibiotics to prevent infection and careful watch over the patient are the main lines employed. When the head has engaged and if cervical dilatation is still insufficient, incisions of the cervix and delivery by forceps are indicated. When however the non-dilatation persists and the presenting part remains high in spite of persistent conservative treatment, cæsarean section may have to be considered in the interests of the baby.

The treatment of cervical rigidity due to organic causes is discussed under anomalies of the cervix.

DYSTOCIA DUE TO ABNORMALITIES OF
THE MATERNAL SOFT PARTS

ABNORMALITIES of the vulva, vagina, cervix and uterus which constitute the maternal soft parts may give rise to difficulties in labour. These abnormalities may be congenital or acquired. Tumours arising from these organs also may give rise to dystocia. This is considered separately in a subsequent chapter.

1. Abnormalities of the Vulval Outlet

There are several conditions of the vulval outlet which may lead to dystocia.

(a) *Atresia of the vulva.* Generally incomplete, this is often accompanied by imperfect development of the sexual organs. If pregnancy occurs in such cases, the second stage of labour is naturally prolonged and may necessitate an episiotomy to avoid extensive perineal tears which may involve the rectum.

(b) *Rigid perineum.* This condition is often met with in elderly primigravidæ and also in multiparæ who have had previous perineal lacerations repaired.

The treatment consists in performing episiotomy.

(c) *Œdema of the vulva.* In pregnancy it is generally due to toxæmia, renal or cardiac diseases, or anæmia. In such cases, the œdema is present not only in the perineal region but also in the labia majora and minora, and is generally bilateral. Œdema of other parts, such as the extremities or the face, may also be present. Such a type of œdema does not cause obstruction to delivery. If the œdema is marked and causes considerable distress it can be treated either during pregnancy or labour by multiple punctures with a needle and the application of hot compresses. During the course of delivery lacerations are liable to occur, and these heal badly. In the presence of œdema it is not desirable to suture such tears, as occasionally the parts slough and cause septic complications.

There is another type of œdema that occurs in prolonged labour as a result of the pressure of the head in the pelvic cavity causing

obstruction to the circulation of venous blood. This œdema mainly involves the perineum and to a much less extent the lower part of the labia on either side. It is not associated with œdema in any other part of the body. It is a sign of prolonged labour and indicates the necessity for a careful investigation of the cause of the delay. Instrumental aid is often necessary in such cases. Tears of the perineum should not be sutured, so that the drainage is free. When the œdema has subsided and the parts are clean, secondary suturing of the perineum may be done.

(d) *Elephantoid growth of the vulva.* This may sometimes lead to severe dystocia. In one case the dystocia was so great that it ended in rupture of the uterus before the woman was brought to the hospital. If the growth is large and likely to give rise to serious obstruction cæsarean section should be preferred to vaginal delivery. In the rest at the time of vaginal delivery bilateral episiotomy may be necessary to overcome the rigidity of the perineum and obstruction. The episiotomy wounds are best left unsutured as they seldom heal well and often get infected.

(e) *Healed scars of infective granulomata.* These healed scars produce such a severe form of cicatrisation that the vulval outlet becomes considerably narrowed and may admit only one finger. In such cases cæsarean is preferable to vaginal delivery.

(f) *Hæmatoma of the vulva.* This is an uncommon complication met with in the second stage of labour. Because of the pressure of the head and the engorgement of the veins, one of the veins gives way and the blood extravasates into the soft loose areolar tissue of the labium, producing a large hæmatoma which impedes the further progress of the head.

The patient experiences intense pain which is sometimes of a tearing nature. A large extravasation of blood burrowing into the loose tissues round about the vulva may cause signs and symptoms of internal hæmorrhage.

The usual treatment in a case of vulval or vaginal hæmatoma is to place the patient at absolute rest in bed. If the course of labour is interfered with on account of the hæmatoma, it is not wise to allow the child to be born without first dealing with the hæmatoma. The hæmatoma should be incised, the clots cleared out, any bleeding points caught and ligatured and the cavity packed with gauze. Thereafter, the child is delivered if necessary with artificial assistance.

Should the hæmatoma develop after delivery, the treatment adopted depends upon the size of the hæmatoma. If it is large, lay it open,

clear out the clots and pack ; if small it may be left to absorb spontaneously. Should suppuration develop it is incised and free drainage established. When the bleeding has been severe, blood transfusion will be indicated.

2. Abnormalities of the Vagina

Incomplete atresia of the vagina is generally associated with sterility. In cases where pregnancy occurs, the atresia may be so pronounced that vaginal modes of delivery may be out of question. Such cases require a cæsarean section.

A double vagina or a septate vagina. In cases of double vagina, if the septum is complete and involves the cervical canal and the uterus, labour is not generally interfered with, as one portion of the vagina dilates while the other is compressed by the passage of the fœtus. When, however, the septum, is transverse it may form a definite band in front of the presenting part and thus cause obstruction. It is necessary in such cases to incise the septum and make the vagina one common canal.

Acquired atresia. This is secondary to inflammatory lesions or traumatic causes generally following labour. It may also follow vaginal operation. In some cases the atresia may be so pronounced and the scarring of the vaginal tissues so great that there is no possibility of effecting any dilatation of the vaginal canal. In others, again, the adhesions may be comparatively mild and readily yield to manual dilatation. Cæsarean section would be necessary if cicatrisation is marked.

Occasionally, the vagina may be encroached upon by tumours of the rectum, as for example syphilitic gummata, malignant tumours of the rectum, or adenomata. In such cases, the treatment will depend upon the degree of resulting obstruction. Cæsarean section will be indicated if obstruction is serious.

3. Abnormalities of the Cervix

Rigidity of the cervix is one of the causes of delay in labour. Such rigidity may be due to Organic or Functional causes.

Organic rigidity of the cervix. This may be due to inflammatory lesions of the cervix and trauma, particularly following child-birth, leading to irregular cicatrix formation. Operations on the cervix, such as amputation and irradiation which result in scarring give rise to rigidity of the cervix.

In a large number of such cases the cervix dilates in a surprising manner, so that during labour the cervix that was considered hard and rigid reaches full dilatation fairly easily. Sometimes, however, the dilatation is delayed or does not occur and artificial aid may be necessary. Rigidity is greater in those cases which follow certain operative measures such as amputation of the cervix.

Treatment. In these cases sufficient time must be given to ascertain the capacity of the cervix to dilate. Labour will be prolonged and assistance often required. Hence reassurance and maintenance of the patient's fluid balance is essential. Prophylactic antibiotic therapy is useful. When, with good uterine pains, labour is not progressing satisfactorily, assistance will be indicated. The nature of the assistance will depend upon :

- (1) The position of the vertex.
- (2) The degree of dilatation of the cervix.

If the head is deeply engaged in the pelvis and the scarring and rigidity is confined to the external os which is only partially dilated while the rest of the cervix is thinned out, then under anæsthesia incision of the cervix at 2, 6 and 10 o'clock positions and delivery by forceps is the best method.

If the head is high, cæsarean section is preferable. A difficult forceps delivery should be avoided after incision of the cervix. In these cases difficulty in delivering the child will result in extension of the cervical incisions which enhances the risk to the mother. If cervical rigidity is associated with a malpresentation like breech or shoulder and the baby is at term, cæsarean section would be the better line of management.

Functional rigidity of the cervix. This is generally noted in elderly primigravidæ or neurotic women who dread labour. It may sometimes occur where the presenting part, generally the cephalic pole, does not fit the lower uterine segment. It is not infrequent in cases of occipito-posterior positions with a minor degree of cephalopelvic disproportion associated with inertia.

A proper understanding of the physiology of uterine action has altered to a certain extent our ideas of functional rigidity of the cervix. This altered conception and its treatment has been discussed under inco-ordinate uterine action.

Labour following Operation for Prolapse. Fothergill's operation and perineorrhaphy are the commonest operations for prolapse. Many pregnancies follow the operation and in some, labour becomes

difficult. The main cause is non-dilatation of the cervix after Fothergill's operation and unyielding perineum after perineorrhaphy. The latter is easily dealt with by an episiotomy, while the problem of the non-dilating cervix is more complicated. The non-dilatation is usually due to organic rigidity resulting from cicatrix formation after operation. Where it is marked, cæsarean section is the best line of treatment. Incision of the cervix is not safe as already the cervix has been shortened by amputation. Vaginal deliveries after prolapse operations often result in recurrence of prolapse. Careful watch is required in labour and once the head is on the perineum it must be delivered without undue delay after an episiotomy.

Œdema of the cervix. This condition may occur either during the course of pregnancy or during labour.

During pregnancy it may occur in cases of generalised œdema or sometimes it results from minor degrees of prolapse of the gravid uterus.

During labour, œdema of the cervix generally involves the anterior lip. In most of the cases, it is due to the pressure of the presenting part, namely the head, on the anterior lip of the cervix before it has been completely taken up and the cervix dilated. A vicious circle results in such cases. With a partially dilated cervix, the head presenting and pressing upon the anterior lip interferes with the circulation, which results in œdema, and as it increases, it in turn causes further obstruction to the course of delivery. In extreme cases of this condition the œdematous anterior lip may be seen at the vaginal outlet, while the head is jammed in the pelvic cavity. When the head is high and œdema of the anterior lip of cervix is present, cephalopelvic disproportion must be excluded as it is commonly encountered in this condition. Occasionally, œdema may be present in the posterior lip of the cervix as well; and rarely both lips of the cervix may be equally œdematous, completely covering the presenting part and obstructing its progress.

Treatment. In most cases where only the anterior lip is involved, it is possible by vaginal manipulation under anæsthesia to dilate the cervix sufficiently to push it above the presenting part. If the œdema is considerable, the cervix may be painted with an antiseptic and the œdema relieved by puncturing with a sharp needle, after which the anterior lip is pushed up above the presenting part. This is sometimes seen in prolapse of the cervix complicating labour.

Occasionally, a portion of the cervix may necrose and slough away during the puerperium.

Malpositions of the Cervix. Sometimes the cervix, instead of being situated in the middle of the pelvic cavity, more or less on the curve of Carus, is displaced anteriorly, posteriorly or occasionally laterally. Generally this follows displacements of the body of the uterus. The cervix may be displaced anteriorly and the external os may be felt actually underneath the symphysis pubis as in known posterior sacculation of the uterus. On the other hand, the external os may be in the hollow of the sacrum, or occasionally pointing towards the sacral promontory as in anterior sacculation. In some cases lateral deviations of the cervix may also result, so that the cervix is pointing to one or other side of the pelvic cavity.

In all these cases considerable difficulty is experienced in the process of dilatation and taking up of the cervical canal, when the uterus contracts. Displacements of the presenting part also occur and the force of uterine contractions is directed towards a cupola formed either by the anterior or posterior sacculi, so that much of the effect of the uterine contractions is lost. In most cases, where extreme degree of displacement of the cervical canal is not present, given time, the obstruction is overcome and the cervix gets taken up. In the more severe cases cæsarean section may be necessary.

4. Body of the Uterus

Dystocia may result from malformations and displacements of the body of the uterus.

Malformation of the Uterus. These are caused mostly by the persistence to a greater or lesser extent of the septum between the Mullerian ducts. It may be recalled that the Fallopian tubes are formed out of the upper portions of the Mullerian ducts up to their point of fusion with each other. From the inferior portions, the uterus and vagina are formed by absorption of the fused inner walls. If the absorption of the inner walls of the ducts does not take place, the uterus and vagina are divided into two lateral halves; should, however, a partial union take place a corresponding degree of malformation results. There are many degrees of these deformities, depending upon the extent to which the fusion and subsequent absorption are deficient.

The malformations met with are:

(1) *Arcuate uterus.* This is the lowest grade of abnormality. The uterus is normal except for a slight depression in the middle line over the fundus giving it a saddle-shaped or arcuate appearance.

(2) *Uterus Didelphys.* Here there are two separate uterine cavities each communicating with its own cervical and vaginal canal. The

two Mullerian tubes have failed to fuse in their lower two-thirds. Each uterine body can therefore be palpated separately.

(3) *Uterus Bicornis Bicollis*. In this condition the upper parts of the uterine portions of the Mullerian ducts remain distinct while the lower parts undergo imperfect fusion. The cervix is single but divided by a median septum and this septum continues into the vagina and divides it also. There is thus a deep depression at the fundus.

(4) *Uterus Bicornis Unicollis*. Same as above, except that there is one cervical and vaginal canal.

(5) *Uterus Septus*. The uterus presents the normal shape externally with no depression at the fundus, but a septum stretches right upto the external os, dividing the body of the uterus and cervical canal into two halves. The vagina is single.

(6) *Uterus Sub-septus*. This condition is different from the preceding one in that the septum does not extend to the whole length of the uterine cavity, being confined to the upper portion for a variable distance.

(7) *Uterus Unicornis*. Here the main body and cervix of the uterus have been developed from one Mullerian duct only and there is a rudimentary horn to one side of it, the cavity of which usually fails to communicate with either the developed horn or the vagina.

Occasionally the uterus itself may be a rudimentary organ or it may be infantile and very much under-developed.

Rarer still there may be a complete absence of the uterus in some cases. In the two last conditions pregnancy does not occur and no question of dystocia therefore arises.

Pregnancy and Labour in Uterine Malformations. Pregnancy in uterine malformations, is sometimes met with. In most cases of uterine deformities, the two portions of the uterus are not symmetrical and equal. Pregnancy occurs usually in one half of the uterus and a false decidua may form in the other half. Not infrequently abortion occurs; in some cases premature labour is the result; in the minor malformations pregnancy often goes to term and ends normally.

The common complications met with are abortion, weak uterine action, post-partum hæmorrhage, and adhesion of the placenta; malpresentations are not infrequent. In cases where labour is prolonged or obstructed, the uterus may rupture due to its poor development. The placenta, if it is formed on the septum, may be adherent and may cause post-partum hæmorrhage.

Uterus Didelphys. In this condition, as there are two complete uteri, each with a distinct body and cervix, pregnancy may take a normal course. Occasionally, delivery may be impeded by the septum in the vagina. In the early weeks of pregnancy the presence of the non-gravid uterus may give rise to the mistaken diagnosis of an extra-uterine gestation. In some of these cases menstruation may occur throughout the course of pregnancy from the non-pregnant uterus.

Uterus Bicornis Bicolis. Pregnancy may occur in either half of the uterus, and when it occurs in one horn of a bicornuate uterus the other undergoes some degree of hypertrophy and a decidua is formed in its cavity. Repeated abortions and breech presentations may occur more frequently than in a normal uterus. Usually, the pregnancy takes a normal course and the delivery is spontaneous. In rare instances the non-pregnant horn of the uterus may impede the progress of labour by obstructing the passage of the head in the pelvic cavity. It is difficult to make a positive diagnosis till the delivery is completed. The presence of a double vagina or a double cervix may possibly give a clue.

With *uterus bicornis unicollis*, the difficulty of diagnosis is even greater, and some cases are not diagnosed till after delivery.

Uterus Septus and Sub-septus. The fundus of the uterus may be normal in outline or occasionally there may be a depression at the fundus (Arcuate uterus). In the majority pregnancy and labour proceed normally but sometimes repeated abortion may occur. Mal-presentations specially breech may be more frequent. In some cases the placenta may be retained or adherent, and it is during the manual removal of the placenta that the condition is generally diagnosed. In a few cases the head or part of the fœtus may pass through the septum.

Uterus Unicollis. Pregnancy is extremely rare in this type of uterine deformity.

Pregnancy in the rudimentary horn is attended with grave risks. This complication is dealt with in the chapter on extra-uterine gestation.

To sum up :—

Minor degrees of developmental defects of the uterus do not usually interfere with pregnancy and labour. A septate or bicornuate uterus may occasionally be the ætiological factor in repeated abortions. Correction of this abnormality by excision of the septum or any form of Strassman's operation will often result in successful pregnancies,

Bicornuate uterus and septate uterus may give rise to malpresentations. Repeated breech presentation and oblique lies may be often associated with such anomalies. In most cases vaginal deliveries occur. Occasionally cæsarean section will be necessary.

Displacements of the Uterus

Not infrequently displacements of the uterus occur during the course of pregnancy. The common forms of displacements that may complicate pregnancy are Backward displacements (retroversion,

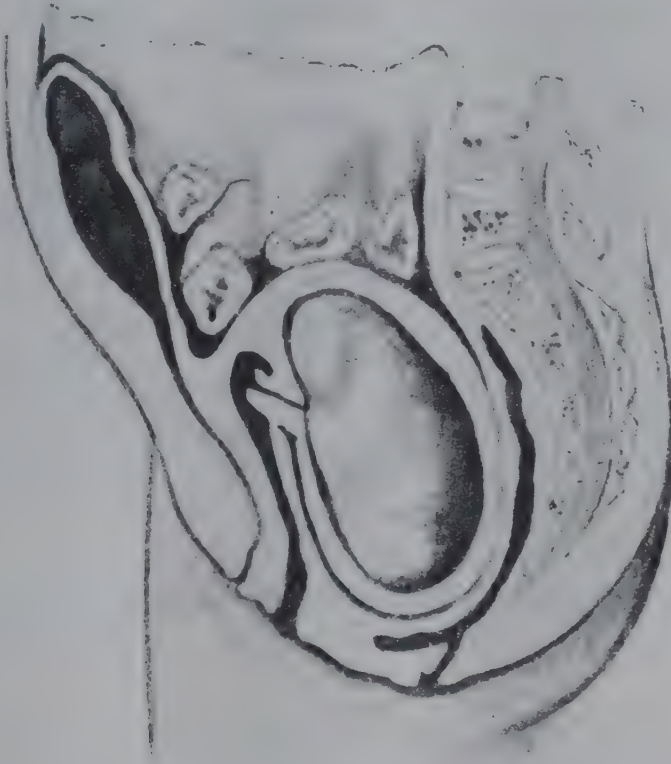


FIG. 114.—Retroverted gravid uterus : incarceration.

retroflexion), Forward displacements (anteflexion, anteversion) and Downward displacements (prolapse of the gravid uterus).

1. Backward Displacements. Pregnancy may occur in a retroverted or retroflexed uterus, or a normally placed pregnant uterus may become displaced backwards. Of these two possibilities the former is much the commoner.

Clinical course. Ordinarily there are no characteristic symptoms. Most often the displacement undergoes spontaneous correction by the twelfth week of pregnancy. Retroversion of the uterus is now considered a normal variant of uterine position and is rarely a cause for abortion.

On very rare occasions a retroverted gravid uterus may become incarcerated in the hollow of the sacrum. As the uterus grows the cervix is pushed forward behind the symphysis compressing the bladder neck. The patient then complains of frequency of micturition, difficulty in emptying the bladder and later inability to void urine. It may also be associated with distension with overflow. As a result of retention of urine severe cystitis may develop. At this stage abortion may occur and the patient relieved of symptoms. Sometimes the pregnancy continues. The anterior wall of the uterus continues to develop with the posterior wall not participating in this development as it is imprisoned in the pelvis. This is termed posterior sacculation. Pregnancy may proceed to term and if the sacculation is marked vaginal delivery is not possible.

Extreme degrees of incarceration resulting in severe cystitis, pyelitis and pyelonephritis necessitating termination of pregnancy are seldom seen in modern obstetric practice. These arise from neglect.

Diagnosis. The diagnosis of a retroverted gravid uterus is not difficult. Whenever the patient complains of difficulty in micturition or retention of urine and backache in the early weeks of pregnancy, a vaginal examination must be done. A careful bimanual examination reveals the absence of the uterine body in front and its presence in Douglas' pouch posteriorly. The level of the cervix is raised and the external os points upwards and forwards towards the symphysis pubis. This affords a very useful indication as to the position of the body of the uterus.

Differential diagnosis. A retroverted gravid uterus has to be distinguished from :—

- (1) Extra-uterine gestation with pelvic hæmatocele.
- (2) Tumours of the ovary.
- (3) A fibroid in the posterior wall of the uterus.

The differentiation of a retroverted gravid uterus from extra uterine gestation with pelvic hæmatocele has been discussed already under ectopic gestation.

In cases of doubt a needle may be passed into the mass in Douglas' pouch, when on aspiration in cases of hæmatocele, blood occasionally of a dark colour is drawn into the syringe.

An ovarian tumour complicating pregnancy can usually be made out as a swelling separate from the pregnant uterus. Urinary disturbances are more common with retroverted gravid uterus except when

the ovarian tumour is impacted in the pelvis. The cervix points upwards in retroverted gravid uterus and can be felt continuous with the mass in Douglas' pouch while with an ovarian tumour the cervix is usually in its normal position.

A Fibroid Tumour in the posterior wall of a pregnant uterus. In such cases the position of the cervix, which will be more or less normal, will be of help. A fibroid tumour in Douglas' pouch is hard. It moves with the uterus and cervix, but gives the uterus an irregular outline

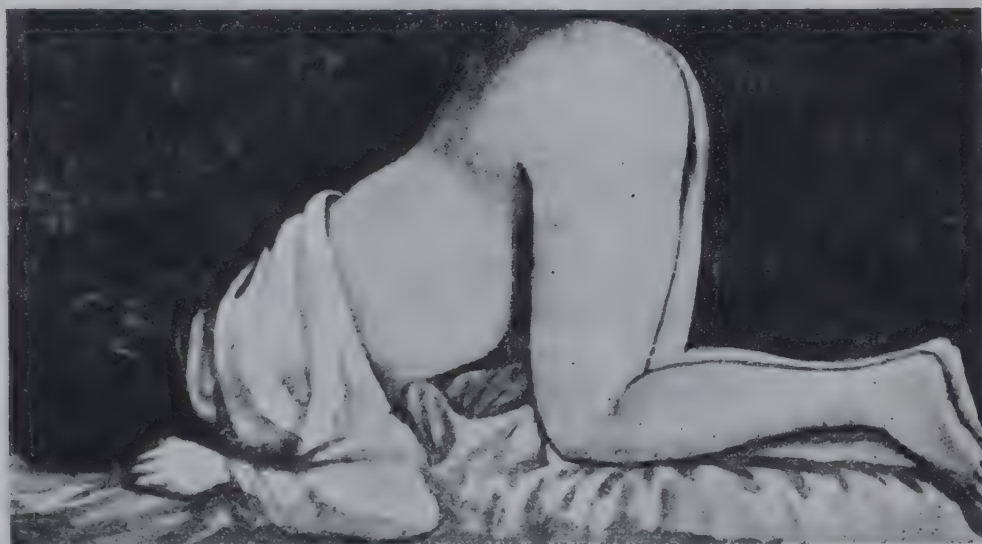


FIG. 115.—Knee-chest position.

and the consistency of the whole mass formed of pregnant uterus and fibroid is not uniform.

Prognosis. In a large number of cases retro-displacement tends to correct itself by spontaneous rectification. In those cases which give rise to symptoms, if diagnosed early, it is generally fairly easy to rectify the displacement of the gravid uterus by one of the methods to be described. If, however, the displacement persists beyond the fourteenth week of pregnancy, the chances of incarceration are increased with the associated dangers due to retention of urine, leading to cystitis and ascending infection of the urinary tract. Abortion may ensue. In neglected cases, the patients die of infection or ureæmia. With modern methods of treatment such cases are rare.

Treatment. These patients usually come with a complaint of retention of urine or with signs of threatened abortion. When the primary complaint is retention of urine, the bladder should be emptied by catheter with all aseptic precautions. The urine should be cultured and examined for pus cells. If infection is present, it should be treated by chemotherapy or anti-biotics. If the uterus is retroverted, postural method of replacement may be tried, failing

which manual replacement. Sometimes continuous drainage of the bladder by an indwelling catheter for a couple of days will help and may be necessary before correction of retroversion. In cases with

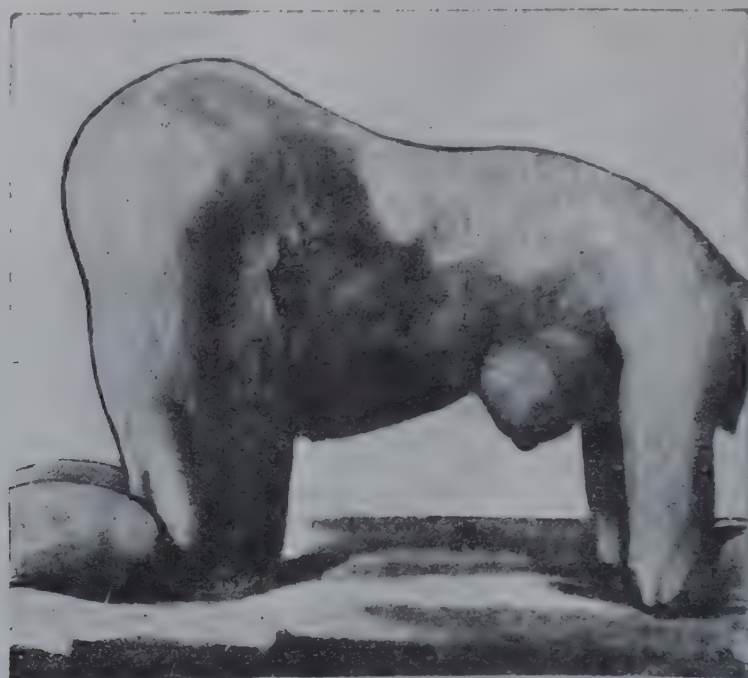


FIG. 116.—Knee-elbow position.

signs of threatened abortion manual methods of replacement should be attempted only after the bleeding has stopped.

(1) *Reposition by postural methods.* The woman is encouraged to adopt the knee-chest or knee-elbow position, morning and evening, for fifteen minutes to half an hour. The effect of this treatment is to favour spontaneous rectification as the uterus grows.

(2) *Reposition by manual manipulations together with postural methods, if necessary.* In most cases of retroverted gravid uterus, it is possible to correct the uterus by bimanual manipulation. In such cases it may be an advantage, while attempting reposition of the uterus, to make the woman adopt the knee-chest, knee-elbow position, or the Trendelenburg position. After completely emptying the bladder and rectum two fingers are introduced into the posterior fornix and with the other hand on the anterior abdominal wall, the fundus is raised upto its proper position and kept there.

After manual reposition a pessary is used to keep the uterus in position and to prevent its slipping back. A suitably sized Smith Hodge's pessary is to be selected which, while maintaining the uterus in a good position, will not slip out of the vagina, or cause undue pressure on the surrounding parts. The pessary should be worn till about the sixteenth or eighteenth week of gestation, by which time the gravid uterus would have grown past the promontory and become an abdo-

minal organ, after which the displacement is not likely to recur as the uterus is by then too large. Once the uterus has become an abdominal organ the pessary should be removed.

It is necessary to point out that manual replacement followed by insertion of pessary is only rarely necessary in these cases. Most often



FIG. 117.—Retroverted gravid uterus : method of replacement.

keeping the bladder empty and postural methods may be all that is necessary as the retroversion corrects itself with the growing pregnancy.

In the rare instances where incarceration has occurred it is necessary to treat the severe cystitis with suitable antibiotic therapy and empty the uterus at the same time either vaginally or abdominally.

Sacculation. A rare complication is posterior sacculation. It can be diagnosed only on vaginal examination when the cervix will be found directed upwards and in marked sacculation under the symphysis pubis or even above it.

Signs and Symptoms. In the early stage the signs and symptoms are referable to retrodisplacement of the uterus, such as difficulty in

micturition, or retention of urine. When, however, sacculation has resulted, the symptoms gradually abate, and not till the patient actually goes into labour may the condition be recognised. When labour starts, the contractions of the uterus do not result in dilatation of the cervix. The extreme displacement of the cervical os prevents its being taken up in the first stage of labour, and the forces of uterine contractions are ineffectual as they are directed towards the cupola of the sacculum and not towards the cervical canal. Labour is thus prolonged, and in extreme cases uterine rupture takes place.

Treatment. In the milder degrees, where the cervix is not very markedly displaced, it could be brought into its normal position by hooking it with the fingers and drawing it down into position. Uterine contractions help to maintain and complete the dilatation for vaginal delivery. If the displacement of the cervix is marked, the best method of dealing with the sacculum is by cæsarean section at term.

2. Anterior (forward) Displacements of the Gravid Uterus.

Two varieties of anterior displacements have been noted: (1) anteversion and (2) antelexion. The normal attitude of the non-gravid uterus is one of slight anteversion and antelexion. It is only in those cases where the position becomes exaggerated that it is pathological. Anteversion is much more common than antelexion of the gravid uterus.

Causes. One of the causes is weak abdominal wall favouring the forward displacement of the gravid uterus, producing the condition known as pendulous abdomen. The anteversion may be so extreme that occasionally the fundus lies at a lower level than the lower pole of the uterus. Multiparæ suffer much more commonly from this affection than primigravidae. With repeated pregnancies the abdominal wall becomes very much weakened and flaccid and the muscles atrophy, so that there is a tendency for anteversion to occur. Divarication of the recti may also take place in these cases, increasing the forward displacement.

The displacement may also be met with, in contractions of the pelvis, particularly in those where there is associated kyphosis, lordosis or spondylolisthesis.

Signs and Symptoms. During pregnancy an abnormal feeling of heaviness and general abdominal discomfort will be complained of in most cases. Pressure and pulling on the bladder may give rise to frequency of micturition. Dragging pains in the loins and difficulty of movements are often experienced.

During labour severe dystocia may arise. The forward displacement results in the cervix being pushed backwards towards the hollow of the sacrum ; occasionally, it may even be above the level of the sacral promontory. In such cases the force of the uterine contractions is directed posteriorly and not along the axis of the birth canal. Dilatation is delayed, the presenting part is displaced posteriorly, and engagement of the head in the brim of the pelvis does not occur. Malpresentations are therefore frequent. Owing to premature rupture of the membranes prolapse of the cord may result. The labour is usually prolonged.

Prognosis. Hazards to mother and fœtus are increased because of the dystocia.

Treatment. In the majority of cases antenatal care will greatly diminish the risks incidental to this condition. The pregnant woman should be fitted with an abdominal binder or corset suited to the period of pregnancy. It is not desirable that she should indulge in any heavy exercises or exert herself in her household duties. During labour the patient should be kept in the recumbent dorsal posture and an abdominal binder applied, so that the uterus may be braced back. Malpresentations, if present, should be corrected. Once the head engages in the brim of the pelvis, labour pains usually proceed in a more orderly manner. There may be delay, however, in the second stage of labour owing to weakness of the accessory muscles of labour, and help may be necessary. Cæsarean section may be indicated where the pelvis is at fault.

Anterior sacculation. This usually results from a badly performed ventral fixation operation for correction of retroversion. As a result the posterior wall of the uterus develops while that portion of the uterus below the level of the fixation forms the sacculum and is unable to participate in the development. It is diagnosed on vaginal examination when the cervix is found right up in the hollow of the sacrum. During pregnancy there may be no symptoms. Labour is often prolonged and obstructed as in posterior sacculation unless the sacculation is of minor degree. In the major degree cæsarean section is indicated.

3. Downward Displacements (Prolapse) of the Gravid Uterus. With prolapse of the first or second degree spontaneous rectification usually occurs as the uterus rises above the pelvic brim dragging the prolapsed hypertrophied cervix with it. In the majority pregnancy and labour proceed normally and complications are uncommon.

When the prolapse is of a major degree—3rd or precidentia—abortion is more frequent. Urinary complications like frequency and retention and infection also are more common because of co-existing cystocele. As the pregnancy continues the prolapsed cervix may recede to a certain extent into the vagina. In some it remains outside the vulval outlet, becomes ulcerated and infected.

When it happens the patient should be put to bed with the foot of the bed raised. The infected cervix should be cleaned and dressed with an antiseptic and replaced in the vagina. It should be kept in position by a sterile vaginal pack which should be changed twice a day. No attempt at replacement of the cervix should be made if there is gross œdema and infection. Rest in bed with the foot of the bed raised and



FIG. 118.—Prolapse of the gravid uterus.
Note the ulceration of the gravid uterus.

antiseptic dressing over the prolapsed cervix will often help to relieve the œdema in a few days and diminish infection. The cervix should then be replaced in the vagina. Once the uterus has grown up well into the abdomen the prolapsed cervix gradually recedes into the vagina along with the growing pregnancy. The patient may then be permitted to walk about.

Occasionally in the early months after replacing the cervix in the vagina a ring pessary may be inserted for a few weeks to keep it in place. The pessary should be removed after the uterus has grown well over the pelvic brim.

In labour in the majority of instances the cervix dilates surprisingly well and vaginal delivery results. In some dystocia results from non-dilatation due to rigidity of cervix and labour is prolonged. Except in a few instances vaginal delivery can be effected by incision of the cervix. In the rest cæsarean section would be necessary. Postpartum hæmorrhage and puerperal infection are other complications.

Hypertrophic Elongation of the Cervix. Closely simulating prolapse is the condition known as hypertrophic elongation of the cervix. Usually, in such a condition, conception is difficult, but when it does, the hypertrophic elongation persists and may cause dystocia.

On bimanual examination the body of the uterus is felt in its normal position. The elongation is purely of the vaginal cervix.

The management of pregnancy and labour is on the same lines as when prolapse complicates pregnancy. There is however one difference. Because of the increase in cervical muscle tissue in hypertrophic elongation it is more difficult of dilatation. Cæsarean section may have to be resorted to more frequently than when prolapse complicates pregnancy. This again depends upon the degree of hypertrophy and elongation.

Cystocele and Rectocele. Cystocele and rectocele complicating pregnancy are usually associated with some degree of prolapse; but either of them may occur independently and give rise to considerable difficulty. They occur usually in multiparæ. In cystocele the difficulty in regard to emptying of the bladder in the early months of pregnancy is exaggerated. Urinary infection is more common.

During labour, cystocele and rectocele may sometimes cause dystocia. With each pain the condition becomes exaggerated and dilatation of the cervix may be interfered with. Occasionally, it may be necessary to press back the cystocele and rectocele to complete delivery. Where artificial assistance is needed, as in the application of forceps, care must be taken to see that the bladder is completely emptied and, when traction is applied, an assistant should press against the anterior vaginal wall and keep the cystocele from descending.

Torsion of the Gravid Uterus. This is a dangerous but fortunately rare complication.

The signs and symptoms are the same as in an acute abdomen—shock, intense pain and tenderness over the uterus. Fœtal heart is most often absent depending upon the degree of torsion. It is difficult to differentiate this condition from concealed accidental hæmorrhage and more often than not the diagnosis is made at laparotomy.

Treatment. This consists in immediate laparotomy. In some cases it may be possible to correct the torsion and leave the pregnant uterus in situ if the fœtus has not been affected by the torsion.

Hysterectomy with or without removal of adnexa may be necessary in cases where the torsion has resulted in gross damage to the uterine musculature and adnexæ.

TUMOURS OF THE UTERUS, ADNEXA AND NEIGHBOURING STRUCTURES COMPLICATING PREGNANCY, LABOUR AND THE PUERPERIUM

TUMOURS arising from any part of the female genitalia may complicate pregnancy. These tumours may be benign or malignant solid or cystic. Fibromyoma of the uterus and ovarian neoplasms are found



FIG. 119.—Multiple fibroids complicating pregnancy (Bumm).

more often in association with pregnancy than any other tumour. Occasionally carcinoma of the cervix may complicate pregnancy.

Fibroids complicating pregnancy. Interstitial, submucous and subperitoneal fibroids of the uterus may be found in association with pregnancy. These may give rise to complications.

Effect of fibroids on pregnancy. In many instances the association of fibromyomas and pregnancy may not be of significance while in some it may give rise to grave complications. Fibroids especially

the submucous variety—diminish the chances of conception and increase the chances of abortion if conception occurs. The rapid growth and increase in size of the fibroids as pregnancy advances produce pressure symptoms depending upon the size and position of the tumours. The commonly observed symptoms are dyspnœa and palpitation. With cervical or retroperitoneal fibroids disturbances of micturition and sciatic pains may also be met with. Malpresentations are more common if fibroids are situated in the lower uterine segment. Premature labour is also more common.

Effect of pregnancy on fibroids. These tumours grow rapidly and participate in the general hypertrophy and growth of the uterine musculature. Both in pregnancy and in the puerperium, they are more likely to undergo degenerative changes particularly red degeneration. Subperitoneal fibroids may undergo torsion. As stated earlier along with the advancing pregnancy they may give rise to pressure symptoms.

Effect on labour and puerperium. Many a time labour and puerperium are normal. However because of their size and location, labour may become complicated. Incoordinate uterine action and uterine inertia may often be met with. Cervical and retroperitoneal fibroids because of their position often give rise to serious dystocia which may result in rupture of the uterus if adequate help is not available. The third stage of labour may be complicated by retained or adherent placenta and postpartum hæmorrhage.

In the puerperium fibroids may undergo red degeneration. Submucous and interstitial fibroids may be extruded out of the uterine cavity or get infected. If the tumours have been subjected to prolonged pressure during labour they may become infected and even gangrenous. Small tumours sometimes undergo involution during puerperium. Acute inversion of the uterus may occur if the fibroid is arising from the fundus.

Diagnosis. The fact that the presence of fibroids is often noted only after confinement, either in the third stage or in the puerperium, serves to demonstrate the difficulty of diagnosing this condition during pregnancy.

Subperitoneal fibroids, specially when pedunculated, will be felt as hard nodular growths projecting from the uterus. Fibroids on the posterior wall of the uterus are less likely to be recognised. Interstitial fibroids may be mistaken for a fœtal part, generally for an elbow or knee when of small size, and for a head or breech when large. The mobility of a fœtal part within the uterus as compared to the immobility

of the fibroid apart from the uterine wall, helps to differentiate the two conditions. Where fibroids obstruct labour, a careful vaginal examination may reveal the presence of the hard growth. It may sometimes be necessary to examine the patient under a general anæsthetic before recognising the condition.

Sometimes fibroids may be mistaken for ovarian tumours. A rarer mistake is to confuse one half of the uterus for a fibroid in a uterus didelphys or bicornis.

The presence of fibroids may give rise to considerable difficulty in diagnosis of pregnancy in the early months. The importance of the pregnancy the test may here be reiterated.

Prognosis. Much depends upon the size, position of the fibroids and complications in pregnancy. Many a time no complications may occur. The prognosis can be grave if proper treatment is not carried out in pregnancy and labour where fibroids do give rise to symptoms or cause dystocia.

The fœtal prognosis is often adversely affected because of the increased risks of abortion, premature labour and dystocia due to fibroids.

Treatment. Certain general principles may be laid down in regard to the treatment.

During pregnancy. As a rule it is wise not to interfere with the fibroids unless a definite indication is present. An attitude of watchful expectancy is most desirable in such cases and seldom is interference indicated during pregnancy.

(a) In the early weeks of pregnancy: Where no symptoms exist, there is no necessity to interfere; the patient, however, should be carefully watched throughout pregnancy. The possibility of abortion occurring in the early weeks should be kept in mind.

(b) In the later weeks of pregnancy interference, because of fibromyomata, may become necessary owing to any one of the following causes :—

(1) Degenerative changes in fibroids, particularly necrobiosis :

Red degeneration is the commonest type of degeneration that occurs in a fibroid during pregnancy. It manifests itself clinically as pain, tenderness over the uterine tumour, slight abdominal distension, some degree of fever and vomiting. With rest, sedatives and antibiotics, these symptoms usually subside in a few days. In some it

takes a much longer time, while in others, recurring attacks may occur. In the majority of cases, the pregnancy can be continued and only in rare instances will laparotomy be indicated because of non-response to persistent conservative therapy.

(2) Serious pressure symptoms. Pressure symptoms may be due either to the large size or situation of the tumour. When the fibroid is of large size, it causes undue distension of the abdomen and pressure on the abdominal viscera and neighbouring structures. Fibroids even though small in size, if they remain within the pelvis, may cause pressure symptoms. If these symptoms are severe and increasing in severity as pregnancy advances it may be necessary to interfere.

(3) Torsion. Occasionally, torsion may actually involve the gravid uterus and give rise to serious symptoms characteristic of acute abdomen. This is most likely with pedunculated subperitoneal fibroids.

When such symptoms arise laparotomy is indicated. Further treatment will depend upon the size and situation of the tumour. The following are the methods of treatment that may be adopted :—

- (i) Enucleation of the fibroid, leaving the pregnancy to continue.
- (ii) Cæsarean section and enucleation of fibromyomata.
- (iii) Cæsarean hysterectomy, sub-total or total.

Cæsarean hysterectomy would be the line of treatment in a multi-gravida with multiple fibroids and pregnancy at the time of laparotomy. Cæsarean section would be indicated in younger women. If the fibroid can be easily enucleated, it may be done. Only the offending fibroid need be removed. Enucleation of the fibroid and leaving the pregnancy alone could be done if the pregnancy is between 20 and 28 weeks, when there is minimum chance of abortion and if myomectomy can be performed easily without involvement of the uterine cavity. The only danger is that, if abortion takes place soon after the operation, it may be difficult to completely evacuate the uterus.

Where pregnancy has reached term, the decision regarding the management of labour should be taken after taking into consideration the age and parity of the patient, the situation of the fibroids and presentation of the fœtus. Cæsarean section will be indicated, if the fibroids are situated in the lower uterine segment or impacted in the pelvis preventing descent of the fœtus. Elective section would be the treatment of choice. If however the fibroids are not situated in the region of the true pelvis and presentation is vertex, a trial of labour is indicated and the patient watched.

(4) Fibromyomata complicating labour. Subperitoneal fibroids may not interfere with the course of labour and in the majority of cases where the fibroids are small, labour terminates spontaneously. A cervical myoma even of small size, because it cannot be lifted out of the pelvis, may cause obstruction to the passage of the fœtus; a sub-mucous fibroid may also interfere with the descent of the presenting part.

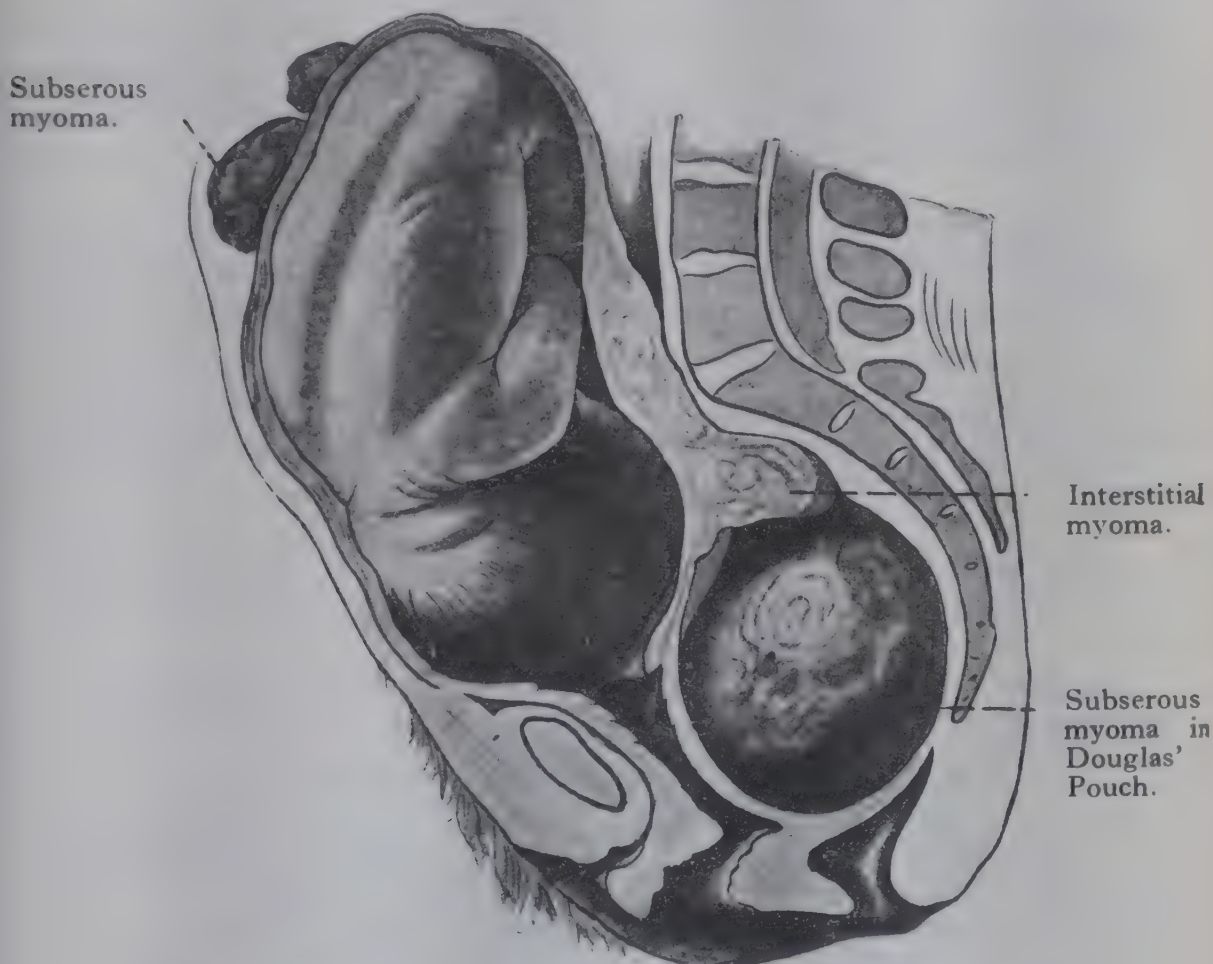


FIG. 120.—Multiple fibroids complicating pregnancy (Bumm).
Note the subserous myoma in Douglas' Pouch.

In cases where fibroids are situated above the pelvic brim and are not therefore likely to obstruct the passage of the fœtus, labour is allowed to proceed under careful supervision. In no case where a fibroid tumour of any size persists in the pelvis is it desirable to extract the presenting part past the obstructing fibroid.

In general, therefore, labour obstructed by myomata is best treated by cæsarean section. When a decision for cæsarean section is taken in these cases, one of three methods may be adopted:—

(1) Cæsarean section followed by myomectomy. This is the ideal method of treatment and should be adopted wherever possible. After the fœtus has been delivered, if the number of fibroids is small and they are so situated that they can be easily removed, myomectomy

should be performed. A danger however, is an increased tendency for the uterus to bleed, and it is not always easy to control the hæmorrhage after myomectomy on a full-term uterus. Moreover the additional risk of infection must also be borne in mind. Myomectomy should be avoided if it is going to be extensive and multiple fibroids are present.

(2) Cæsarean section followed by hysterectomy, total or sub-total. This is the method generally preferred in cases where the uterus is too extensively diseased to be of much service later. Where the fibroids are multiple and the woman is a multipara, the proper line of treatment is to perform cæsarean hysterectomy. Total hysterectomy is preferable to sub-total hysterectomy,

(3) Conservative Cæsarean Section. This is a controversial method of treatment, for it does not deal with the fibroids and not only makes a subsequent operation essential but leaves room for the possibility of degenerative changes or other complications developing in the puerperium. Myomectomy in pregnancy and labour has a slightly higher mortality. Hence some prefer delivery by cæsarean section and do the myomectomy two to three months later.

Sometimes uterine inertia may complicate labour when cæsarean section will have to be done even if there is no obstruction by fibroids.

In those delivered per vaginum, there is a greater incidence of adherent placenta and postpartum hæmorrhage. The Obstetrician will be well advised to be prepared for these complications.

(4) Fibromyomata complicating the puerperium. Although labour may have terminated vaginally troubles may arise during the puerperium because of the presence of fibromyomata. This generally occurs in the submucous and interstitial varieties. Subserous ones may occasionally be injured during labour, undergo torsion of the pedicle or even sometimes to torsion of the whole puerperal uterus. The changes that may occur are degeneration and infection. At times an interstitial fibroid may tend to become submucous and give rise to hæmorrhage, and a submucous one may become polypoid and predispose to inversion.

It is difficult to differentiate between degeneration and infection for in both the symptom and signs are almost identical namely—pain and tenderness over the uterus, elevation of temperature, mild abdominal distension and occasional vomiting. In severer degrees of infection these symptoms are much more marked than in degeneration and there may be offensive lochial discharge as well.

The treatment is mainly conservative in the early stages—namely rest, sedatives and antibiotics. Majority of these cases respond to

conservative therapy. If however response is poor it may be necessary to resort to surgical procedures. Submucous fibroids protruding into the vagina especially if pedunculated should be removed by the vaginal route. For the rest hysterectomy especially if infection is present is indicated. Myomectomy for an infected fibroid in the puerperium is not advisable.

A word of caution may be given here with regard to the treatment of submucous fibroids. It is necessary to be quite sure about the diagnosis of this condition, as not infrequently inversion of the uterus has been mistaken for a small submucous fibroid situated near the fundus.

In all cases where fibroids have been noted during the puerperium, the patient should be cautioned, examined eight to twelve weeks later, and suitable treatment adopted.

Ovarian tumours complicating pregnancy and labour. All varieties of ovarian tumours—solid or cystic benign or malignant—may complicate pregnancy. The commoner varieties met with are simple serous or multilocular cysts and dermoids.



FIG. 121.—Ovarian tumour obstructing labour (Bumm).

Effect of pregnancy on ovarian tumours: Pregnancy does not appear to have any particular effect upon the growth of ovarian tumours

unlike its well-known effect on uterine fibromata. Other changes may take place, such as torsion, rupture or infection. Infection is more likely to occur during the puerperium than in pregnancy. Incarceration, suppuration and necrosis may also take place. This is more frequently so with dermoid cysts which have a tendency to remain in the pelvis than with the ordinary types of simple serous or multilocular cysts.

Effects of ovarian tumours on pregnancy—These depend upon the size and situation of the tumour. In the early weeks of pregnancy ovarian tumours may give rise to pressure symptoms particularly referable to the bladder. There is a greater tendency for abortion. In the later weeks if of large size pressure symptoms usually associated with an over-distended abdomen may be manifest. Malpresentations are likely where the ovarian tumours remain either wholly or partially pelvic.

Symptoms: Ovarian tumours may not give rise to any symptoms if they are of moderate size and not confined to the pelvis. Sometimes they give rise to complications.

When an ovarian tumour such as a dermoid is impacted in the pelvis, pain, frequency of micturition and retention of urine, constipation, shooting pains down the thighs may be present.

If the tumour is of large size it produces pressure symptoms generally from the twenty-eighth week of pregnancy onwards as in association with the gravid uterus, the abdomen becomes over-distended; dyspnœa, precordial pain, dyspepsia, constipation, difficulty in micturition and symptoms referable to pressure on abdominal viscera may be noticed.

Torsion: This complication occurs during pregnancy—more often during the puerperium. It is slightly more frequent in association with pregnancy than in the non-gravid condition. 12% as against 8%. The symptoms are: Sudden and severe pain in the abdomen associated with all the features of shock and collapse; tenderness and a slight amount of abdominal rigidity may also be present.

On abdominal palpation the tumour may be palpable and if it has been previously noted an increase in its size may be observed. Torsion may be more gradual, in which case pain and associated symptoms are less severe.

As a result of torsion, the tumour may rupture or give rise to peritonitis. In some cases it may become adherent to the bowels and get infected.

Rupture of an ovarian cyst is comparatively rare during pregnancy.

Infective changes (Suppuration and necrosis) are probably due to conditions quite independent of the gravid state. It may follow torsion or suppuration may have existed before the onset of pregnancy. Suppuration, however, is more likely to occur postpartum if there is puerperal infection.

Diagnosis: The diagnosis is not usually difficult. When the tumour is in the pelvis and the pregnancy is not far advanced, a careful bimanual examination will reveal the presence of the tumour alongside of the enlarged uterus.

In the later weeks, the tumour may be felt either in the pelvis or in the abdomen by palpation as a distinct tumour separate from the gravid uterus. In some cases a groove could be seen separating the tumour from the pregnant uterus. Where the tumour is cystic and large and there is a considerable amount of enlargement of the abdomen, it may be difficult to define the outlines of the tumour and the gravid uterus separately. It may then be mistaken for hydramnios. An ovarian tumour may be mistaken for a fibroid.

In the earlier weeks of pregnancy a small ovarian cyst may be mistaken for an extra-uterine gestation. Particularly is this mistake likely to arise when it undergoes torsion. The acute attack of pain and collapse, together with the finding of a soft tender swelling which may occasionally be pulsatile in the pouch of Douglas, may give the impression of a ruptured extra-uterine pregnancy. A laparotomy is indicated in both conditions, and the diagnosis at times may only be cleared up at operation.

Management. When an ovarian tumour complicating pregnancy is diagnosed, it is best to remove it. Two important aspects must be borne in mind.

(1) Abortion rate is minimal after removal of tumour, if the pregnancy is between 16 and 20 weeks.

(2) Removal of the tumour before it gives rise to complications like torsion also tends to keep the abortion rate low after operation. With torsion, the abortion rate is about 30%. In other words when the tumour is removed prior to 16 weeks or when it has undergone torsion, the chances of abortions are greater. Hence the present practice is to remove a quiescent tumour diagnosed in early pregnancy, between 16th and 20th week. At any time, when torsion takes place, irrespective of the period of pregnancy, operation must be undertaken.

When laparotomy is undertaken for torsion of ovarian tumour near term (after 36 weeks), it is best to do a cæsarean section, empty

the uterus and then remove the tumour. A full term pregnant uterus, unless it is emptied, makes a simple ovariectomy a difficult procedure. Sometimes laparotomy may have to be done to remove the tumour when pregnancy is only 24-32 weeks. In such cases, after operation, the patient should be watched for onset of premature labour. This is a danger one may have to face.

In all cases, after laparotomy and removal of tumour, the patient should be kept under the influence of sedatives for 48-72 hours to minimise the chances of abortion or premature labour. There are some who believe that administration of 25 mgm. of Progesterone parenterally daily for a week after the operation diminishes the risk of abortion, especially in the early months. One factor which will help continuation of pregnancy is that the pregnant uterus should be handled to the minimum and never roughly during the operation.

Ovarian tumours and labour

If an ovarian tumour is situated within the pelvis it will most likely obstruct labour. It is also liable to injury if vaginal delivery takes place. Occasionally such trauma during labour may cause even rupture if the tumour is thin walled and cystic. When the tumour is above the pelvic brim, it may not interfere with the progress of labour; but at times uterine inertia may set in.

Treatment

If the tumour is situated above the presenting part and obstruction is not likely, vaginal delivery is permissible and the removal of the tumour considered at a later stage. If the tumour lies in the pelvis or is likely to cause obstruction, it is better to deliver the woman by caesarean section and remove the tumour at the same time.

During the puerperium ovarian tumours tend to suppurate, especially if damaged during labour. Another complication met with is torsion which is favoured by the rapid involution of the uterus during this period, the laxity of the abdominal walls and the increased mobility of the abdominal viscera. The incidence of torsion of ovarian tumour in the puerperium is higher than at any other time and is nearly 25%. Hence it is best to remove the tumour as early as possible in the puerperium before infection or torsion occurs.

Cancer of the cervix complicating pregnancy

Of all genital cancers, that of the cervix is the commonest and since it occurs even during the reproduction period, it is the commonest type of cancer found complicating pregnancy, though among the complications in pregnancy it is a rare one. Among 15,804

deliveries in the Women and Children's Hospital Madras there were 6 cases of cancer of the cervix complicating pregnancy, an incidence of 1 in 4,300.

Effect of Pregnancy on Cancer—Diverging views are expressed on the effect of pregnancy on carcinoma. Because of the increased vascularity and high hormonal levels in pregnancy, some believe that cancer spreads and advances more rapidly during pregnancy, while there are others who believe that there is no such effect. The consensus is that there is no actual proof that pregnancy enhances the rate of growth or spread of the tumour.

As far as the pregnancy itself is concerned, especially in advanced cases, the chances of abortion are very much enhanced. In the early months, vaginal bleeding due to the cancer is mistaken for signs of threatened abortion and in later months for placenta prævia.

Diagnosis. Diagnosis is often made on clinical examination and in advanced cases presents no difficulty. In all cases of vaginal bleeding in pregnancy, before resorting to a vaginal examination, a speculum examination to inspect the cervix should be carried out. Any ulceration or frank growths will be easily revealed and the characteristic friability and bleeding on touch looked for. In all cases biopsy will confirm the diagnosis. The cervical epithelium undergoes hyperplastic changes in pregnancy which may stimulate malignancy. Hence, in the very early stages, a diagnosis of malignancy on biopsy during pregnancy should be made with caution.

Labour in cases with cancer cervix is attended with risk. Unless the cancer is in the early stages and the lesion small it may be dangerous to permit vaginal delivery of a mature fœtus. Laceration of the cervix and profuse hæmorrhage may result from such delivery. This danger is greater in advanced cases. However, we have come across some cases of advanced cancer delivered per vaginum without any such complication.

Prognosis. The prognosis, as in all cases of cancer, depends upon the stage of the disease and the facilities for proper treatment. If expert treatment is made available, the general opinion is that the five-year cure rates are in no way significantly less than in the non-gravid condition. It is worth-while remembering that the younger the age at which cancer starts, the worse is the prognosis. If that be so cancer cervix in pregnancy may have a higher mortality, as it occurs usually in much younger age groups.

Treatment. There are two accepted lines of treatment in the early stages, namely, radical hysterectomy (Wertheims or Schauta's)

and radiation therapy. In the hands of experts both give equally good results. Late cases are always treated with radiation.

When cancer is diagnosed in pregnancy, except under exceptional circumstances, the pregnancy must be ignored and cancer treated effectively, whatever be the stage of the disease. When, by waiting a week or ten days a fairly mature foetus can be obtained with a good chance of survival, there may be some justification to delay the treatment of cancer, for the sake of the foetus, by this short period.

In pregnancy with early cancer, either surgery or radiation, according to the surgeon's choice, is the treatment. Surgery in these cases can be hazardous because of the increased vascularity but the dissection is more easy due to looseness of the cellular tissues. Except in those cases where the growth is confined to the cervix and is small in area, it would be advisable to evacuate the uterus by abdominal hysterotomy, prior to radiation therapy, if that be the treatment preferred for the cancer. Many radiologists consider that radiation could be given safely with the foetus in utero and that spontaneous expulsion will occur after intra-uterine death, without any complications. But where the lesion is not confined to a small area, evacuation by instruments if it becomes necessary may be hazardous and hence we prefer to empty the uterus by abdominal hysterotomy prior to radiation. Nearer term, the uterus is emptied by caesarean section—classical—prior to radiation therapy. Classical caesarean section is preferred as it is unwise to have an incision in the lower segment nearer the cancerous area. Radiotherapy can usually be started in these cases within a week to ten days of operation.

Vaginal neoplasma

If diagnosed during early pregnancy, surgical removal would be indicated. If seen in late pregnancy or labour and the tumour is likely to cause obstruction, caesarean section would be the better line of management and the tumour removed later. If the tumour is small and not likely to cause obstruction vaginal delivery should be allowed and the tumour removed at a later date. Carcinoma, and sarcoma of the vagina complicating pregnancy are very rare.

Vulval neoplasma mostly benign may sometimes complicate pregnancy. These tumours could be removed during pregnancy. Rarely do they obstruct labour necessitating caesarean section.

CONTRACTED PELVIS

IN A contracted pelvis one or more of the diameters, in one or more of the planes, is shorter than normal. The contraction may be at the brim of the pelvis, cavity or at the outlet, or the brim, cavity and the outlet may all be involved. The contraction may also be symmetrical or asymmetrical and so causes several varieties of deformity.

It is not possible to state definitely what constitutes a normal pelvis, for it depends upon several factors and varies in different countries. It is therefore wiser to lay down standards for particular countries and communities, rather than adopt a uniform standard for all. What may be styled a normal pelvis in some of the European countries differs from the Indian standard and this in turn differs from the standard of the inhabitants of Africa. Taking these facts into consideration, it may be stated that deviations in size or shape from the normal standard of each country or race constitutes a contraction of the pelvis.

Contracted pelvis is a common cause of dystocia.

Various factors influence the size and shape of the pelvis. Socio-economic and genetic factors may influence pelvic shape and capacity. These pelvic variations may result from disease or other factors.

Until recent years only the grosser forms of variations of definite pathological origin were identified or could be identified in the living subject. To-day by expert radiographic technique even the minor deviations from the normal, the result of developmental variations in pelvic formation, have been revealed and their importance appreciated.

The two principal causes of pelvic deformity are errors of development which include those due to dietetic and environmental factors in early life and diseases of the pelvic bones. Pelvic deformities are also produced or aggravated by abnormalities in spine or lower limbs.

Various methods of classification of contracted pelvis are in vogue. The one favoured by the majority would appear to be a classification based on ætiology. Munro's classification is given below:

1. Deformities arising from faulty development:

(a) Justo-major pelvis.

(b) Justo-minor pelvis or generally contracted pelvis.

- (c) Simple flat non-rachitic pelvis.
 - (d) Nægele's pelvis—imperfect development of one sacral alæ.
 - (e) Robert's pelvis—imperfect development of both sacral alæ.
 - (f) Split pelvis—Imperfect development of pubis.
 - (g) Assimilation pelvis.
2. Deformities arising from diseases of the pelvic bones and joints:
 - (a) Rickets.
 - (b) Osteomalacia.
 - (c) New growths.
 - (d) Fractures.
 - (e) Atrophy, caries, necrosis.
 - (f) Diseases of sacro-iliac and sacro-coccygeal joints.
 - (g) Luxation of sacro-iliac joint.
 3. Deformities resulting from diseases of the spinal column:
 - (a) Kyphosis.
 - (b) Scoliosis.
 - (c) Spondylolisthesis.
 4. Deformities arising from disease of lower extremities:
 - (a) Coxitis.
 - (b) Dislocation of one or both femurs.
 - (c) Atrophy or loss of one limb.

In addition, group 1 has to be modified to include a variety of pelves in which pelvic architecture does not conform to the accepted type as already made out by pelvic radiography.

In discussing contracted pelvis, therefore, we have to take into account the variations in pelvic shape to which Caldwell and Moloy have drawn special attention.

Frequency. The frequency of contracted pelvis is variously estimated by observers in different countries. This is possibly due to the lack of a definite standard being available for classifying contracted pelves; the greater incidence of certain ætiological factors such as rickets and osteomalacia in some countries naturally leads to the more frequent occurrence of contracted pelves in such countries.

The commoner varieties of contracted pelves are:—

- (1) The generally contracted pelvis (the small gynæcoid).
- (2) The flat pelvis (Platypelloid).
- (3) The generally contracted and flat pelvis (small gynæcoid and Platypelloid).

Others, less frequently encountered, are the funnel-shaped pelvis (Android), the triradiate pelvis (Osteomalacic) and the obliquely distorted pelvis (Nægele's).

Diagnosis of Contracted Pelvis. Along with various improvements in obstetrics in the last twenty-five years, a definite reduction in the incidence of the very severe degrees of contraction of the pelvis is also noticeable. Rickets and osteomalacia were the prime ætiological factors in such contractions. Better nutrition and better standards of living in early life and eradication of these diseases have resulted in such diminution. Even so, dystocia due to faults in the pelvis continues. It is now mainly due to the variation in shape of the pelvis and cephalopelvic disproportion. A pelvis may be normal according to measurements but the foetal head may be too big for that pelvis. The result in labour is the same as in a contracted pelvis. Hence, in discussing the diagnosis and management of contracted pelvis, the diagnosis and management of cephalopelvic disproportion is included. In fact, it is now more customary to talk in terms of cephalopelvic disproportion than contracted pelvis.

A pelvis has a brim, cavity and outlet. The contraction may affect the pelvis at all levels or it may be confined to any one level. Ordinarily a pelvis contracted in all its diameters at the brim is also contracted in the cavity and outlet. It is not unusual to find a pelvis contracted in the cavity and outlet, while pure outlet contraction alone is uncommon. Again, the contraction may affect either the anteroposterior diameter, or the transverse diameter, or both. A contraction in one diameter may be compensated for by an increase in the other diameters. Hence, in assessing the possibilities of vaginal delivery, the obstetrician would do well to take into consideration the capacity of the pelvis as a whole at all levels.

The importance of diagnosing the existence of a contracted pelvis before the onset of labour must be clearly realised. Careful attention must be paid to the following :

History

(a) *General.* Rickets, osteomalacia, poliomyelitis, tuberculosis of the hip joints and fractures involving the lower extremities or pelvis affect the pelvic shape and capacity. In history taking these may be enquired into.

(b) *Obstetric.* In a parous woman the history of previous deliveries gives important information. Safe vaginal delivery of normally sized live undamaged babies at term usually denotes a pelvis of normal capacity. Per contra difficult vaginal delivery ending in still birth

or neonatal death, in the absence of other ætiological factors would be strongly suggestive of contracted pelvis or cephalo-pelvic disproportion.

Physical examination

Short statured women have a tendency to have a smaller pelvis and in many cases the babies also tend to be smaller. Even so, it is wise to be on guard against pelvic dystocia in women who are less than average in height. In South India the average height of women in the poorer class is about 150 cms. Pendulous abdomen, deformities of the spine especially those involving the lower lumbar region, shortening of a lower limb, tilting of the pelvis and waddling gait are factors which make the pelvis suspect and hence must be looked for in physical examination.

Evidence of rickets—rickety rosary or deformities of the chest—if present would suggest pelvic deformity.

Obstetric examination

An unengaged or floating head in a primigravida at term should always arouse the suspicion of a contracted pelvis or cephalo-pelvic disproportion. While deflexed attitudes of the head prior to the commencement of labour are perhaps a more common cause, pelvic contraction should be ruled out before coming to such a diagnosis. It is also to be remembered that deflexion may simulate or exaggerate disproportion.

Pelvimetry

External pelvimetry of the brim was once very much in vogue to diagnose pelvic contraction. The diameters measured were inter-crystal, interspinous and external conjugate. Because of the very poor accuracy of these measurements in relation to the actual diameters and relatively poor information obtained from them, in modern obstetrics, external pelvimetry of the brim is seldom employed. On the other hand, external pelvimetry of the outlet yields more reliable information and hence is of value. Contractions of the brim can always be diagnosed even early in labour and suitable treatment adopted. If contraction of the cavity and outlet is not diagnosed prior to labour but realised only late when the head is obstructed, the results can be disastrous to the child. Hence it would be wise to measure by external pelvimetry the diameters of the outlet. The commonly measured diameters are—

1. *The transverse diameter of the outlet.* This is the distance between the inner surfaces of the two ischial tuberosities. It can be measured either by special calipers (Jarchos or Thomas) or by putting

the patient in lithotomy position, marking the inner surfaces of the tuberosities and measuring it off with a scale. With a normal outlet the space between the tuberosities will accommodate four knuckles of the closed hand. This distance is on an average about 10.5 to 11 cms.

2. *The antero-posterior diameter of the outlet.* It is the distance between the tip of the sacrum and the undermargin of the symphysis pubis. It can be measured by an ordinary pelvimeter and is usually about 12.5 cms.

3. *The posterior sagittal diameter of the outlet.* It is the distance between the mid-part of the transverse diameter and sacral tip measuring on an average about 7 cms. These three measurements give a fair idea of the pelvic outlet.

The subpubic arch is estimated by direct palpation. This is best done during the course of a vaginal examination by sweeping the fingers from side to side. It normally measures about 85 degrees. A narrow arch by itself may lead to some delay when the head reaches the perineum and there is often a marked increase in the incidence of perineal tears in such cases.

Thus by external pelvimetry more definite information can be gained about the outlet. It is unwise to draw conclusions regarding the nature of delivery by any one measurement. The capacity of the pelvis at all levels is the important consideration. For this more information is required. This is obtained by internal pelvimetry and radiography.

Internal Pelvimetry. Two methods are employed :

- (1) By instruments.
- (2) Digital or manual examination.

Many ingenious instruments have been devised for measuring the internal capacity of the pelvis. As the margin of the error is not small and most of the instruments are cumbersome, internal pelvimetry by instruments is seldom employed at present.

Vaginal examination. This is one of the most valuable methods of assessing pelvic capacity, and however accurate other methods may be, this method must never be omitted. During a vaginal examination to assess pelvic capacity the following must be looked for :

- (1) *The subpubic arch.*

(2) *The ischial spines*—there should be no marked projection of the ischial spines into the pelvic cavity—the ischial bispinous measurement can be roughly gauged.

(3) *The sacral concavity* from promontory to the sacral tip should be well developed so that at mid pelvic and higher level, the bone can be reached only with difficulty. A flattening of the sacrum is an unfavourable sign which may produce 'transverse arrest'.

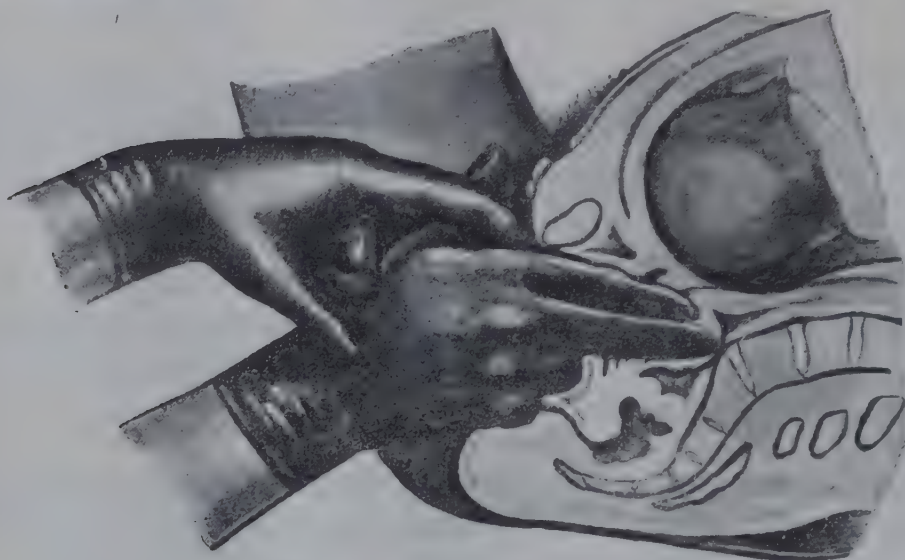


FIG. 122.—Internal pelvimetry.
Method of measuring the diagonal conjugate.

(4) *The length of the sacro-tuberous ligament* (the sacrosciatic notch). Normally two fingers can easily be placed over this ligament. It serves as a useful index of the adequacy of the pelvis at lower levels. Less space indicates a narrowing of the sacrosciatic foramen and diminished capacity of the lower pelvis.

(5) *The pelvic side walls.* These should be palpated, normally they are parallel and sometimes divergent. Converging side walls are an ominous sign.

(6) *The diagonal conjugate.* To obtain this measurement the middle and the forefinger of the right hand are passed into the vagina until the middle finger impinges on the promontory. The forefinger of the other hand then marks off the lower margin of the subpubic ligament. Both hands are then withdrawn and the distance between the tip of the middle finger and the point marked by the forefinger is measured with rod or calipers. The true conjugate is estimated by deducting 1.5 to 2 cms. from this measurement. Here again it must be stated that various factors influence the accuracy of the measurement. They are the depth of the pubic symphysis (the deeper it is, the more must be deducted), the inclination of the pubic symphysis to the horizon (the more obtuse it is, the more must be deducted) and the height of the promontory (the higher the promontory, the more must be the deduction). A false promontory is sometimes found, which may give again a wrong reading. In spite of all these drawbacks, it gives useful information.

From what has been stated, it is evident that a vaginal examination gives very essential information in assessing the pelvic capacity at all levels. Carefully done after the 36th week of pregnancy, it provides very valuable and reliable data. This examination must be done as a routine in all primigravidæ and in all multigravidæ with bad obstetric history. The best time to do it is after the 36th week and it also enables not only to assess pelvic capacity but also to assess cephalopelvic disproportion. If the disproportion is to be assessed this examination can be postponed to nearer term say, after 38 weeks.

Assessment of Cephalopelvic Disproportion.

This can be done by abdominal palpation or by bimanual examination. The latter is a better procedure and is known as the Munro-Kerr-Müller method. The

patient is placed in the dorsal position and the obstetrician stands at her side facing her. The left hand grasps the head and presses it into the pelvic brim while two fingers of the right hand are passed into the vagina under all aseptic precautions. The thumb of the vaginal hand palpates the head over the symphysis. By this method the relative size of the fœtal head and maternal pelvis is gauged and from the extent of the descent of the head into the pelvis or the degree of over-riding of the head over the symphysis a diagnosis of no disproportion, mild disproportion or major disproportion can be made.

The one important fallacy of this prediction is that, if done prior to labour, a deflexed head may simulate disproportion and hence give rise to wrong prediction. However, once active labour has started and the preliminary adjustment between the head and the brim has taken place, the accuracy of this method is enhanced. Prior to labour a mild disproportion can be exaggerated by deflexion which is usually corrected during active labour pains.

Simple methods of pushing the head and judging by Pawlick's grip

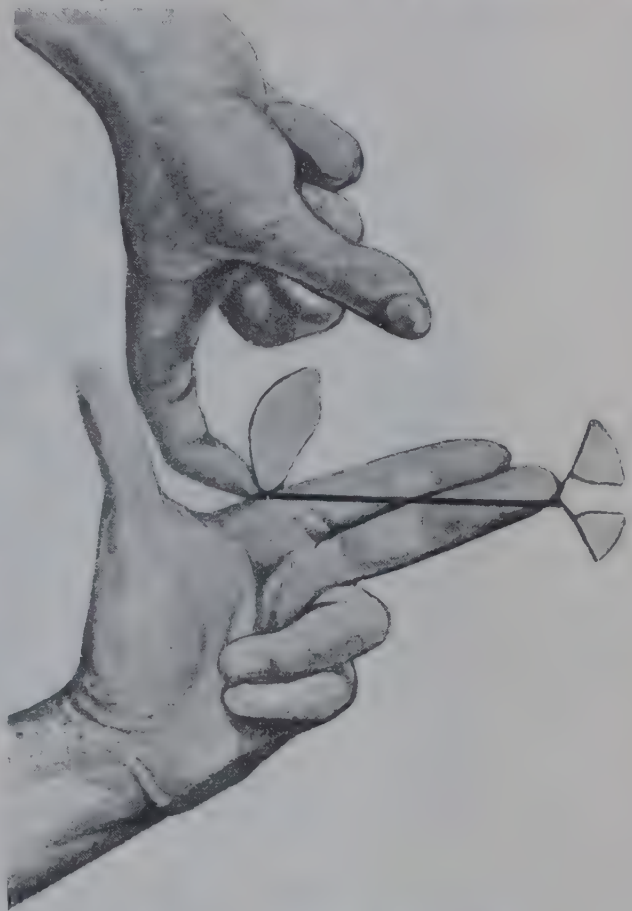


FIG. 123.—Internal pelvimetry.
Method of measuring the diagonal conjugate schematic.

can be tried but the bimanual method described above gives more accurate information. But its limitations also should be recognised.



FIG. 124.—Munro-Kerr-Müller method of estimation of disproportion.

Even so it must be made an essential part of routine ante-natal examination near term in all primigravidæ with unengaged head and all multigravidæ with bad obstetric history.

Radiological estimation of pelvic capacity and diagnosis of cephalopelvic disproportion. Developments in radiographic technique have now made it possible to measure accurately all the important diameters of the pelvis at all levels—brim, cavity and outlet. It is not our aim to enter into a discussion regarding the various techniques employed and their merits and demerits. In America the use of the precision Stereoscope has been popularised by Caldwell and Moloy but the apparatus is so expensive and its use demands very highly specialised skill that for routine work it is not possible, especially when more direct methods are available. Most methods depend more or less on four standard views of the pelvis which between them give all the necessary information regarding capacity and shape. The four views are (1) the direct lateral (2) the direct antero-posterior (3) the accurately positioned supero-inferior picture of the brim and (4) the outlet.

The lateral radiograph. This is taken with the patient in an erect lateral position. The tube is centred over the ischial spines. Exact measurements in the sagittal plane are made possible by the incor-

poration of a scale graduated in centimetres which is placed in the cleft between the buttocks. If the position adopted is correct, the radiograph will show that the ischial spines are superimposed and the acetabula nearly so. From this film the following measurements can be obtained: (1) the antero-posterior diameter at all levels, (2) the depth of the pelvis, (3) the inclination of the pelvic brim and symphysis, (4) the distance of the ischial spines below the plane of the brim and, (5) the inclination and curve of the sacrum and shape of the sacrosciatic notches. Apart from these, it offers the best view for measuring the biparietal diameter of the foetal head and shows the relation of the head to the brim.

The supero-inferior radiograph of the brim. The patient sits on the film holder supported by a back rest placed at an angle of $35-40^{\circ}$. In this position the pelvic brim is approximately parallel to the film. If the patient has been positioned correctly, the resulting radiograph shows the outlines of the superior and inferior pubic rami superimposed. Such a picture gives an accurate idea of (1) the shape of the brim (2) the length of the widest transverse diameter of the brim (3) the interischial spinous diameter and (4) the position of the presenting part.

The outlet radiograph. For this the patient sits with the thighs fully abducted and the trunk forward as far as possible between them. This brings the pubic arch parallel to the film and the tube is centred over the ischial tuberosities. From this the subpubic angle can be measured. The intertuberous diameter also can be measured but it is not accurate. The character of the pelvic side walls also can be noted.

The antero-posterior radiograph. A straightforward picture taken with the patient supine gives the following information: (1) the direction of the pelvic side walls and (2) the interischial bispinous diameter.

Thus useful and accurate information is made available by radiopelvimetry. In fact, it is only by radiopelvimetry that the transverse diameter of the brim can be accurately measured.

Unless a pelvis is markedly contracted it is unwise to decide the mode of delivery by considering only any one diameter. Contraction in antero-posterior diameter can be compensated by increase in transverse diameter. What gives a more correct idea is the pelvic capacity at all levels and for this accurate measurements of diameters at the brim, cavity and outlet are necessary.

Assessment of Pelvic Capacity. Various methods are in use. Only a few will be mentioned.

The Pelvic Brim. An obstetric conjugate of 10 cms. is considered as border-line by most workers. But experience has shown that by

itself it is not of much significance. A transverse diameter of 12 cms. is also considered as border-line but again, like the obstetric conjugate, by itself it is not of much significance unless markedly contracted.

Pelvic Indices. Various indices have been described. Allen considers the inlet to be an ellipse and uses the formula for an ellipse to determine the inlet area taking the measurements of antero-posterior and transverse diameters of the brim. When the brim area is over 130 sq. cms., vaginal delivery is certain without any evidence of disproportion. Between 105 and 130 sq. cms. vaginal delivery is reasonably certain but there may be evidence of minor disproportion. Between 105 and 85 vaginal delivery is uncertain and below 85 vaginal delivery is extremely unlikely. This is a useful method of assessing prognosis but because of variations in the foetal skull, it must leave the obstetrician in some doubt regarding the outcome.

The Cavity. If the sacrum is well curved the sacrosciatic notches are wide, ischial spines are not prominent and the pelvic side walls not convergent, it is most unlikely that difficulties will be encountered in the cavity. If the sacrum is flat, forward rotation may fail and if the pelvic side walls are convergent, deep transverse arrest is common. The midplane transverse diameter is the shortest possible distance between the ischial spines. The midplane posterior sagittal diameter is that segment of the antero-posterior diameter which is posterior to its inter-section by the transverse diameter. The course of labour is most eventful at the line of the ischial spines particularly in occipito-posterior positions. It is here that the cardinal movements of internal rotation and descent must occur simultaneously while flexion must be maintained or re-established. In general, it may be stated that, with bispinous diameter of less than 9.5 cms., vaginal delivery is difficult. If the midplane contraction as indicated by a shortening of the transverse diameter is associated with a shortening in the antero-posterior diameter, the difficulties are further enhanced. The caesarean section rate is high in these cases. If the area is calculated by multiplying the antero-posterior diameter and transverse diameter according to Allen, the critical level lies between 75 sq. cms. and 90 sq. cms. Below this figure, the prospect of vaginal delivery is doubtful and when the area falls below 75 sq. cms. the prognosis is bad. Increased moulding of the foetal head and expansion of the pelvic cavity, due to the 'give' in the pelvis during labour, reduce the accuracy of these radiological forecasts.

The Outlet. Contraction of the outlet alone without midcavity involvement is very uncommon. The diameters of importance at the outlet are: (1) the transverse diameter—10.5 cms., (2) the antero-posterior diameter—12.5 cms., (3) Posterior sagittal 7.5 cms., and (4) subpubic angle 80° . Any angle considerably below 75° may result in

dystocia. The pubotuberous diameters measuring the pelvic depth must be studied. The normal is 9-10 cms. Eleven centimetres is considered deep and should be compensated by an increase in the bituberous diameter to avoid a narrow subpubic angle.

Comparing the bituberous diameter alone and forecasting the result leaves much to be desired. By a consideration of the pubotuberous diameter, the subpubic angle and the pubic arch, more definite information can be gained. All agree that forecasts of the outcome of labour based on pelvimetry are much less accurate at the outlet than at the brim. This is partly due to the greater expansion of the lower pelvis in labour.

Cephalometry. If the size of the foetal head could be determined at term in relation to the pelvic capacity it would be very valuable in the forecast of labour. There are great difficulties associated with the measurements of the foetal skull. However it is now possible by ultra sound techniques to measure accurately the bi-parietal diameter. The value of cephalometry is limited as the capacity of the head to alter its shape and diameters by moulding during labour is always an unknown factor.

It is observed that pelvic radiography and radiopelvimetry can give very useful information. What must be realised is that all these measurements and values of pelvic capacity should not make the obstetrician surrender his clinical sense. Except in those cases where obvious contractions exist, in the rest it would be inadvisable for an obstetrician to resort to elective cæsarean section on radiological evidence alone. There are certain unpredictable factors during labour. These are the moulding of the foetal skull, the increase in the capacity of the lower pelvis and the uterine action. The effect of these can be realised only after labour is well established and hence information gained by radiography should only be used to supplement the observations obtained on clinical examination. It gives the obstetrician a greater confidence in that he has a good visual and arithmetical impression of the pelvis at all levels.

The hazards of radiation are well known. Therefore radiopelvimetry should be done only where it is definitely indicated. It should not be used as a routine. Secondly, the number of pictures taken should be the minimum. One erect lateral view will give most of the information required and for the rest reliance must be on clinical examination. It is our practice now to take one erect lateral radiograph only in cases of suspected disproportion in primigravida or in multigravida with a bad obstetric history. At times, a supero-inferior picture of the brim is also taken to get a clearer idea of the pelvic shape.

Prognosis. The maternal and foetal prognosis is considerably influenced by early diagnosis and proper management. If no proper care is available the results can be disastrous for both mother and child. As a result of obstructed labour, the mother may die from rupture uterus and foetus from asphyxia. With moderate degrees of pelvic contraction vaginal delivery after prolonged obstructed labour often results in a still birth or a badly traumatised baby which dies in the neonatal period. Trauma to the foetal scalp may result in cephalhæmatoma. Especially in flat pelvis depressed fracture of one of the parietal bone caused by the projecting sacral promontory may occur. Extreme moulding of the foetal head may result in intracranial hæmorrhage and neonatal asphyxia.

Due to the prolonged pressure by the presenting part—usually the vertex—on the vagina and surrounding structures—the bladder and rectum—pressure necrosis may occur in the puerperium resulting in vesicovaginal or recto-vaginal fistulæ. Of these the former is more common. Strong expulsive efforts on the part of the mother to effect delivery may result in forcing the foetal head through the pelvis as a result of which rupture or subluxation of the symphysis pubis may take place. The sacro iliac joints may also be involved in subluxation. Fracture or fracture dislocation of the coccyx and sacrococcygeal joint is likely to occur. Prolonged pressure on the sciatic nerve and nerve roots results in neurological complication confined to the lower limbs. Foot drop is not uncommon. Morbidity is more common in the puerperium due to infection and in neglected cases fistulæ formation may occur.

MANAGEMENT OF LABOUR IN CONTRACTED PELVIS

ALL cases of suspected contracted pelvis should be delivered only in well equipped specialist hospitals and never on the domiciliary service.

There are three methods of management of labour in contracted pelvis or cephalopelvic disproportion. They are :—

- (1) Elective cæsarean section.
- (2) Trial labour.
- (3) Induction of premature labour.

Before embarking on a discussion of these methods, we wish to emphasise that there is no place for domiciliary midwifery in the management of cases with disproportion. All such cases, and even suspect cases, must be conducted only in institutions fully equipped and staffed to meet any eventuality.

(1) Elective Cæsarean Section. Where the pelvis is markedly contracted or the cephalopelvic disproportion gross, as assessed by clinical and radiological examination in the last few weeks of pregnancy, elective cæsarean section at term would be the treatment of choice. Elective section may also be indicated even in minor degrees of disproportion or contraction of the pelvis if there are other complicating features like elderly primiparity, toxæmia, bad obstetric history, post-maturity, persisting malpresentation like shoulder and breech. The indications would be greater if the contraction of the pelvis is present at more than one level.

Controversy exists as to the timing of the elective cæsarean section. There are many who advocate doing it at full term prior to the onset of labour. The advantage claimed is that the operation can be done under ideal conditions as a planned procedure and not as an emergency. Others recommend that the operation be performed at the onset of pains. The advantages for this procedure are (1) the lower uterine segment would be better formed which facilitates the operation, (2) the bleeding during operation is less as the uterus is already contractile, (3) the baby would have had the maximum intra-uterine existence and (4) the dilatation of the cervix permits better drainage of lochia. As against these, the disadvantages are : (1) The operation would have to be done as an emergency procedure since labour may start at any time. (2) Sometimes patients may not go into labour for some days

after term when the question of post-maturity may complicate the issue and sudden intra-uterine death due to placental insufficiency may occur during the waiting period. We are mostly in favour of operating at the onset of labour for one main reason that most of the hospital class of patients are not sure of their dates and fallacies of estimating foetal maturity under such circumstances are only too well known. It is not uncommon to perform a planned caesarean section under such circumstances only to deliver a premature infant. Especially in our country, where prematurity is so common and accounts for over a third of neonatal deaths, every attempt must be made to give the baby the maximum benefit of intra-uterine life. Where, however, the patient is sure of her dates and the obstetrician is convinced of the maturity of the foetus, we are not averse to doing a caesarean section as a planned procedure at term. Elective lower segment caesarean section should not ordinarily have any maternal mortality, and the foetal mortality should be less than 2%, if the section is done within 4-6 hours of onset of labour.

(2) Trial Labour. Gross deformities of the pelvis demanding elective caesarean section are becoming rarer. A vast number of cases fall into the suspect group where examination reveals a slightly borderline pelvis with mild to moderate contraction or a mild to moderate degree of cephalopelvic disproportion. Even with accurate knowledge of the pelvic shape and size and that of the foetal head, the outcome of labour in these cases can seldom be foretold until the patient has been in labour for some time. During labour there occurs an adjustment between the foetal head and pelvis which would ordinarily favour progress, the foetal head moulds in such a manner that minor degrees of disproportion are overcome and at lower levels the pelvis itself expands in labour with the descent of the foetal head thus giving more room and removing the effects of mild contraction at these levels. All these are brought about by effective uterine contractions. At present there is no method by which we can forecast the nature and strength of uterine contractions in any labour, the degree of moulding of the foetal head which will ensure safe delivery of the child and the amount of expansion of the pelvis in labour. These are the factors which help in overcoming mild to moderate degrees of disproportion and help vaginal delivery. And the obstetrician takes advantage of these factors which occur only in labour by submitting these cases to what is known as 'trial labour'.

An important factor necessary for a 'trial labour' is the presence of good uterine contraction. The effect of such contractions can be gauged best after the rupture of the membranes and in the second stage of labour, for it is the second stage pains which are most effective in producing head moulding and descent. Hence,

for a long time, trial labour was given a time limit. Trial labour was not considered to be complete until good uterine contractions have gone on for at least two hours after the cervix is fully dilated and the membranes ruptured. Some state that conclusions can rarely be drawn from a trial, until it has gone on for at least twelve hours. Attempts to define the limits of a trial labour in terms of time have thus given rise to much confusion. The time element has become less important since the advent of antibiotics, prior to which infection was a deterrent to cæsarean section late in labour. There is clear evidence that maternal mortality and morbidity increase when cæsarean section is done after labour has lasted 6-8 hours. Hence prior to the advent of antibiotics, decisions had to be made earlier in labour than now when the danger from infection is far less and the safety of cæsarean section even after prolonged labour is far greater. In the conduct of a trial labour, however, many factors besides time have to be considered in deciding when and by what method the patient is to be delivered. When uterine action is strong and frequent, a decision can be made sooner than when it is weak and inefficient. When the contraction or disproportion is only at the brim of the pelvis, a longer trial can be allowed. Once the difficulty at the brim is overcome, labour will end quickly. If, however, it is associated with contractions in the cavity and outlet also, as in generally contracted pelvis, such long trials will certainly be disastrous to the child as it has to successfully negotiate succeeding difficulties. A young woman will be able to stand a trial labour physically and emotionally better than an older one. The most difficult type of labour to manage is the one complicated by marked uterine dysfunction where labour is often prolonged and progress slow, adversely affecting the fœtus and mother. Very often a decision cannot be reached until after the membranes have ruptured but sometimes, because of fœtal or maternal distress, earlier interventions may be required. Hence, it is better to start a trial labour without setting a time limit. It is justifiable to continue a trial labour as long as progress is being made and safe vaginal delivery seems very possible provided the risk therefore to the mother and fœtus is not great. Each case must be individualised. In some, a decision may have to be taken early in labour, while others can be continued for a much longer time, before a decision is made.

For a trial labour, cases must be carefully selected. There is no justification in putting down all patients with disproportion for a trial labour, even though cæsarean section done late in labour is, under modern conditions, fairly safe. As a matter of fact, the safety so afforded is unfortunately reflected in a tendency to postpone a decision till labour is well advanced. This has resulted in a large number of failed trial labours. This is not a correct attitude to take. A careful examination in the last week of pregnancy will help in weeding out cases

with gross disproportion for elective section and with no disproportion for vaginal delivery. Only the suspect group should be put down for trial labour and if a careful selection is made the incidence of failures in trial labour would not be more than 10-15%, provided no complications arise during the trial.

For a trial labour, the presentation must be vertex. Any other presentation is a contra-indication for a trial labour. The foetus must not be post-mature—that is to say it is best that the patient does not go beyond term—in any case not more than a week. Apart from the dangers of moulding in a post-mature head, one has to accept the dangers of placental insufficiency also after term. Such babies are unsuitable to stand the stress of a trial labour. The most favourable type of pelvis is the one that is contracted only at one level in one diameter—that is the flat or platypelloid pelvis.

The Conduct of Trial Labour. The patient must be psychologically prepared to stand a prolonged labour and gaining her confidence is essential to success. Fear must be abolished. Her general strength must be maintained and supported. When labour begins, careful note must be made of the nature and frequency of the uterine contractions, the amount of fluids taken and the urinary output. The urine should be frequently tested for acetone which indicates dehydration and starvation. Maternal pulse and foetal heart must be frequently observed. Sedatives should be administered to ensure enough rest and sleep but without interfering with the uterine contractions or adding to the danger of foetal anoxia. Pethidine 100 mgm. intramuscularly and repeated every 6 hours is commonly employed. The progress of labour should be observed by abdominal palpation. Vaginal examinations should be restricted and employed to the minimum. We are not in favour of rectal examination. At the time of rupture of the membranes, a vaginal examination should be done assuming that we are dealing with a case in which the pelvis has been assessed in the antenatal period. Certain important details should be noted at this examination: (1) the nature of the cervix, (2) the position and situation of the head, (3) any prolapse of the cord, (4) re-assessment of the degree of disproportion, and (5) degree of moulding of the head and caput formation.

One of the unfavourable complications in a trial labour is the occurrence of prolapse of the cord at the time of rupture of the membranes, especially in those with the foetal head still at the brim. This, if not immediately diagnosed and treated, is fatal to the foetus. Hence the necessity for a vaginal examination at this stage. Further, during labour certain signs are evident which, if present, are of good prognosis in that they point to a successful vaginal delivery, while there may be

others of bad import indicating probable failure of trial labour. The signs of good prognosis are :—

- (1) Good uterine action.
- (2) Early engagement of the head.
- (3) Rupture of the membranes after full cervical dilatation.
- (4) Well thinned out and effaced cervix closely applied to the vertex.
- (5) The shape of the pelvis. A flat pelvis without any cavity contraction is the most favourable one.
- (6) Vertex anterior position.

When these are present, trial labour is almost always successful in that the vaginal delivery can be effected with safety to the mother and the child. *per contra* the signs of bad prognosis are :—

- (1) weak uterine action,
- (2) slow descent of the head,
- (3) premature rupture of the membranes,
- (4) uneffaced partially dilated cervix hanging loose like a cuff ; occasionally œdema of the anterior lip of the cervix due to it being nipped between the head and symphysis pubis,
- (5) occipito-posterior position of the head, and
- (6) Android pelvis or a generally contracted pelvis.

When these are present, trial labour seldom results in vaginal delivery of an undamaged live child and hence cæsarean section may have to be considered.

At this stage, when labour has been in progress for some time, an intrapartum radiography—lateral picture—is very useful as it gives a correct idea of the degree of moulding of the fœtal skull and the exact level of the head in relation to the pelvis. Each time the case must be reviewed after careful consideration of the rate of progress and the condition of the mother and fœtus. Abdominal palpation helps to assess the descent of the head. Usually, decision to terminate the labour is made only after rupture of the membranes. Fœtal or maternal distress occurring at any time during a trial labour is an indication for immediate termination of labour, abdominally if the head is unengaged, and vaginally, if conditions are fulfilled for such a procedure. Sometimes such fœtal distress may occur even prior to rupture of the membranes. When after rupture of the membranes and good pains the labour is progressing satisfactorily, as made out by the descent of the head, the patient in all probability can be delivered *per vaginam*. When the head comes on to the perineum in these cases, instead of waiting for spontaneous delivery, it would be advisable to deliver by outlet

forceps under pudendal block anæsthesia. Already the fœtal head has undergone good moulding and it would be unwise to allow such a head to be on the pelvic floor for any length of time just for the sake of obtaining a spontaneous delivery.

If, however, the progress in labour is unsatisfactory and in spite of good uterine action the descent is slow and cervical dilatation is poor, labour should be terminated by lower segment cæsarean section. It is difficult to fix any time limit before such a decision is made. With good uterine action ordinarily there should not be much difficulty in making a decision. The difficulty is great when uterine action fails and either inertia or inco-ordinate uterine action sets in. Under such conditions, it is not only a trial to the patient but to the obstetrician also. Sedatives and intravenous drip of glucose to control dehydration are essential. Careful watch of the fœtal heart and maternal pulse is imperative. Antibiotics should be administered prophylactically. A decision under the circumstances should not be unduly postponed. In any case we do not postpone it beyond 24 hours. There are many cases on record where trial has ended successfully after 48 and 72 hours. There is now enough evidence demonstrating that the incidence of peri-natal mortality steadily rises after the first 24 hours of rupture of the membranes and after 48 hours, it is nearly doubled. Even if one gets a live child after this long delay it should not be considered satisfactory unless the baby is sound and undamaged. The aim of good obstetrics is to deliver undamaged babies. The damage done to these babies need not be visible or gross at birth. Obstetricians are mostly concerned now with the aftermath of minor degrees of damage to the brain sustained during delivery. Such damage may be the result of anoxia or intracranial stress, and while the baby may survive the neonatal period, later in infancy as it grows up, the results of this damage are exhibited in the form of retarded mental and at times physical growth. Modern obstetrics tries to avoid the hazards of a difficult delivery mainly with the aim of obtaining an undamaged child and non-traumatised mother. Hence, undue prolongation of a trial labour is undesirable. It is true that cæsarean section is rendered safe but the mortality in cæsarean section is greater with increasing time after rupture of the membranes. The hazard certainly is greater for the baby, for neonatal pulmonary complications are more common in babies delivered hours after rupture of the membranes and tardy labour despite administration of prophylactic antibiotic therapy to the mother in labour.

Uterine Dysfunction and Trial Labour. The crux of the problem in trial labour is the uterine action and dilatation of the cervix. None can predict the nature of uterine action in any labour. The obstetrician relies heavily on it for a successful termination of trial

labour. Two types of uterine dysfunction are met with—hypotonic inertia and inco-ordinate uterine action. Of these the latter would appear to be more common in these cases of disproportion, less amenable to treatment, often vitiating the trial and ending in a cæsarean section. In the hypotonic types, labour ultimately sets in properly.

A trial labour is classed as successful if vaginal delivery of a live, undamaged child is obtained with the mother also in good condition. The vaginal delivery may be either spontaneous or helped by forceps. It is a failure if it results in the delivery *per vaginam* of a dead child or a baby dying in the neonatal period. It is also a failure if delivery is by cæsarean section.

If uterine action and cervical dilatation are not interfered with, the rate of successful vaginal delivery could be as high as 90% or more, if the cases have been properly selected. Trial labour is contra-indicated in cases of (1) toxæmia (2) malpresentations (3) elderly primigravida (4) dystocia-dystrophy syndrome (5) outlet contraction (6) where any cardiac or pulmonary lesion or a disease like diabetes complicates pregnancy and (7) post-maturity.

(3) Induction of Premature Labour. *Induction of premature labour*, as a method of treatment in cases of contracted pelvis, was in vogue to a large extent a few decades ago. A wider experience and a more correct appreciation of the limitations of this method of treatment, have greatly narrowed the indications for induction of premature labour.

If used at all, induction should be performed at a stage when the child is not merely viable, but is capable of withstanding the pressure-effect during its passage through the genital tract and being born alive, and of continuing to live after delivery. Induction is not justifiable before the 36th week of pregnancy, and, indeed, should be done preferably after the 38th week. The advantages claimed are that at this period of pregnancy the head is relatively smaller and softer than at full term and can therefore mould to a greater degree and thus overcome the minor degree of disproportion in border-line cases of contracted pelvis. On the other hand, it is possible that induction may fail to initiate good labour pains even after 24 hours in which case cæsarean section is the only alternative. Further there are many cases on record where after a successful induction and vaginal delivery the same women have delivered safely vaginally babies of greater weight than in the previous ones. This fact demonstrates that induction was unnecessary. Lastly in the developing regions of the world where low birth weight is so common and accounts for over 60% of perinatal deaths induction prior to term may be a greater fetal hazard. The consensus is not in favour of induction of premature labour for disproportion in a

primigravida. It has however a place in the management of dystocia due to large babies in multi gravidæ.

Particularly in a tropical country where the average weight of the fœtus is one pound less than the average weight of the European child, and where the chances of survival are less owing to various factors causing an increased neonatal mortality, the necessity for optimum conditions at birth is so obvious that one should hesitate before inducing premature labour for the sake of the fœtus.

For these reasons, we have for some time discarded the practice of induction of premature labour in cases of cephalo-pelvic disproportion.

The Place of Forceps. It is a dictum now to avoid delivery by forceps if the head is not engaged, i.e., forceps delivery is contra-indicated if the greatest diameter of the head is not completely gone through the brim of the pelvis. Sometimes in the course of a trial, after full cervical dilatation, the head may get arrested in the midcavity and in spite of good uterine action, there may be no progress. The reason for this may be a transverse position of the head or milder degrees of contraction of the cavity of the pelvis as in android pelvis. The choice at this stage would be cæsarean section or rotation and forceps delivery. Much depends on the obstetrician's clinical experience and judgment. Many avoid difficult forceps and prefer cæsarean section. Especially in cases of midcavity dystocia there are some who advocate 'trial forceps'. By this is meant that the obstetrician is not committing himself to vaginal delivery at any cost but in the operating theatre, under a double set-up with everything ready for cæsarean section, he makes an attempt at forceps delivery. If he finds difficulty he does not persist in it but resorts to cæsarean section without unduly jeopardising the child. 'Trial forceps' must be distinguished from 'Failed forceps'. In the latter the obstetrician has decided only on vaginal delivery and every effort is made to get the baby out by traction with forceps. But he fails. The difference between these two varieties is obvious. When a 'trial forceps' is undertaken, it must be only with the full understanding of its significance. We would not commend it to anyone except a very experienced obstetrician. One less experienced should resort to cæsarean section.

For cases seen late in labour where the head is jammed and with a large caput, the fœtus moribund or dead, craniotomy would be the treatment of choice.

Symphiotomy-Pubiotomy. These are operations essentially meant to gain some enlargement in the diameters of the pelvic cavity and outlet. Prior to the era of antibiotics and chemotherapy, when

cæsarean section done late in labour had a high mortality, symphysiotomy or pubiotomy was frequently resorted to when the head got obstructed in the cavity or outlet. With the safety now afforded, these cases are in most clinics dealt with by cæsarean section, though there are certain clinics where it is still commonly practised with good results.

Symphysiotomy or pubiotomy is not advocated for contraction of the brim. It is useful only in minor degrees of contraction restricted to the outlet and lower levels in the cavity. Thus when the head has deeply engaged and an attempt at forceps delivery has failed due to mild contraction, symphysiotomy will help to complete delivery by enlarging the outlet. Great nicety in judgment is required in making the decision. Trauma to the urethra and bladder and vagina are not infrequent and in the hands of any one other than an expert it is associated with great risks to the mother and the child. This operation has been discarded by us for years now.

Caldwell-Moloy Classification. Among the many classifications suggested to differentiate pelvic variations, that of Caldwell and Moloy has been widely accepted. They postulated that the shape of the pelvis is affected by two distinct factors (1) an evolutionary influence which tends to change the shape of the pelvis from a long oval (anthropoid) through a round form to a transverse flat type and (2) a hormonal influence which produces male characteristics in a female pelvis. There is sufficient evidence to indicate that social background and nutrition in the formative years affect the shape of the pelvis. Women in the upper economic group are of better physique with better health than those living in poverty and poor surroundings. The anthropoid type of pelvis is more often found in the tall, slim, well-developed athletic type of woman while the short statured poor woman has often a small gynæcoid pelvis with a flattened brim. There is also evidence to suggest that the Android pelvis is due to stunting of growth on account of faulty diet and living conditions in the growing years, and not to an endocrine change brought about by the action of male hormone.

Caldwell and Moloy from observations on the dry pelvis and röntgenologic examination of the living subject have classified the variations in the female pelvis into four parent or pure types, each demonstrating a characteristic inlet shape with a characteristic mid and lower pelvic morphology.

The classification is as follows :

- (1) The Anthropoid type.
- (2) The Gynæcoid type.
- (3) The Android type.
- (4) The Platypelloid type.

The Anthropoid Type. The inlet has a long oval appearance. The antero-posterior diameter is longer than in the gynæcoid type and the widest transverse diameter is narrower. The posterior segment of the inlet is long and narrow. The width of the sacrum is reduced. The sacrosciatic notch is very wide, wider than in the gynæcoid type. A typical anthropoid pelvis shows straight side walls and a subpubic arch of moderate size. Some pelves of this type may have converging side walls with a narrow interspinous and intertuberous diameter and a narrow subpubic arch.

The Gynæcoid Type. The inlet is round or slightly ovoid or elliptical in shape. The transverse diameter is little longer than the antero-posterior diameter. The anterior segment is wide and well rounded. The sacrosciatic notch is of medium size, sacral curve and inclination average, the subpubic arch wide (Norman arch), pelvic side walls straight, with wide interspinous and intertuberous diameters.

The Android Type. The android type is a pelvis which possesses major masculine characteristics. The inlet is wedge-shaped in appearance with a narrow retrograde subpubic angle. The posterior segment is flat and wide. The sacrosciatic notch is narrow, sacrum tends to be straight with a forward sacral inclination. The subpubic arch is narrow (Gothic arch), pelvic side walls are converging with narrow interspinous and intertuberous diameters.

The Platypelloid Type. The typical platypelloid pelvis, commonly called the flat pelvis, presents a well-formed transverse oval appearance at the inlet. The transverse diameter is very wide and the antero-posterior diameter is below normal in size. The widest transverse diameter intersects the antero-posterior diameter closer to its mid point than in any other type. The sacrosciatic notches are average in size. The pelvic side walls are usually straight and the subpubic arch is very wide. Occasionally, converging side walls, with a narrow subpubic arch, have been found with these types. The typical flat pelvis is shallow.

While these are the four parent types, quite a number do not conform to the classical parent types. They show a mixture of the characteristics of different types. These are termed 'Intermediate forms' and to indicate the type one has to take into consideration the features of the posterior and anterior segments of the brim. The transverse diameter of the brim divides it into anterior and posterior segments. Thus, an android-gynæcoid pelvis means that the posterior segment has the characteristics of an android pelvis, while the anterior segment is gynæcoid. In this way Caldwell and Moloy claim that almost all pelves can be classified into either the parent types or the intermediate forms.

For many years obstetricians have been interested in the correlation between physical stature and pelvic forms. Usually in a woman with a gynæcoid pelvis the shoulders are slightly narrower than the hips. The waist measurement is narrow. The broad hips show a well-rounded appearance from waistline to knees. The lower legs are slender and the inner aspects of the thighs and knees do not approximate in the erect position. In the true anthropoid type the shoulders are wide and muscular, and hips narrow. The individuals are tall and slender but short forms also occur. The legs are straight and slender, the inner aspects of the thighs, knees and lower legs being approximated. In the android form a square bodily appearance in relation to the shoulders, waistline and hips is noticeable. There is a tendency for the thickest, short, individual to predominate, although the tall, muscular, heavy-boned types also are seen. The lower legs are thick and straight throughout. Thickness of the thighs usually stops at the knees in the gynæcoid type but in this the thickness continues to the calves, ankles and feet. The platypelloid form is difficult to correlate with any physical type.

Caldwell and Moloy have discussed the obstetric significance of the different types of pelvis stated above.

The Gynæcoid Type. The small, generally contracted form of pelvis in this type is of obstetric significance. Such a pelvis usually occurs in women of small stature, and as the fœtus is also relatively small, occasionally engagement of the head occurs and delivery is effected by the vaginal route. If the head fails to engage and the cephalopelvic disproportion is obvious, cæsarean section is the operation of choice.

The Android Type. This is the most dangerous type of pelvis from the obstetric point of view. If the head engages in the transverse diameter of the pelvic brim, the prominent sacrum and narrow posterior pelvis force it forward into the narrowed anterior portion. Here, the pelvis being more of the funnel-shaped variety, owing to the general convergence of the four walls of the pelvis towards the outlet, the head meets with increasing resistance as it descends. In the larger forms of this type mid-pelvic arrest occurs, where forceps is difficult to apply and version and breech extraction are equally dangerous. If the extreme types are identified before the onset of labour, cæsarean section is the safest procedure to adopt.

The Anthropoid Type. In this type, the antero-posterior diameter of inlet is long and the transverse diameter relatively narrow. The promontory of the sacrum is high, the sacrosciatic notch is broad but shallow and the symphysis deep and wide. Depending upon the degrees of contraction of the transverse diameter of the superior strait,

the foetal head of average size may not engage in the transverse diameter and will be found floating above the brim at term. Engagement is possible only in the antero-posterior or oblique diameter. Where the transverse diameter is mildly contracted and the cavity and outlet are adequate, spontaneous delivery is the rule. Delivery with face to pubes is more common in this type of pelvis than in any other. Attempt at rotation of an occipito-posterior when it has reached low levels in this type of pelvis is not justifiable. It is better to deliver it as occipito-posterior. In the extreme forms-particularly when narrow-

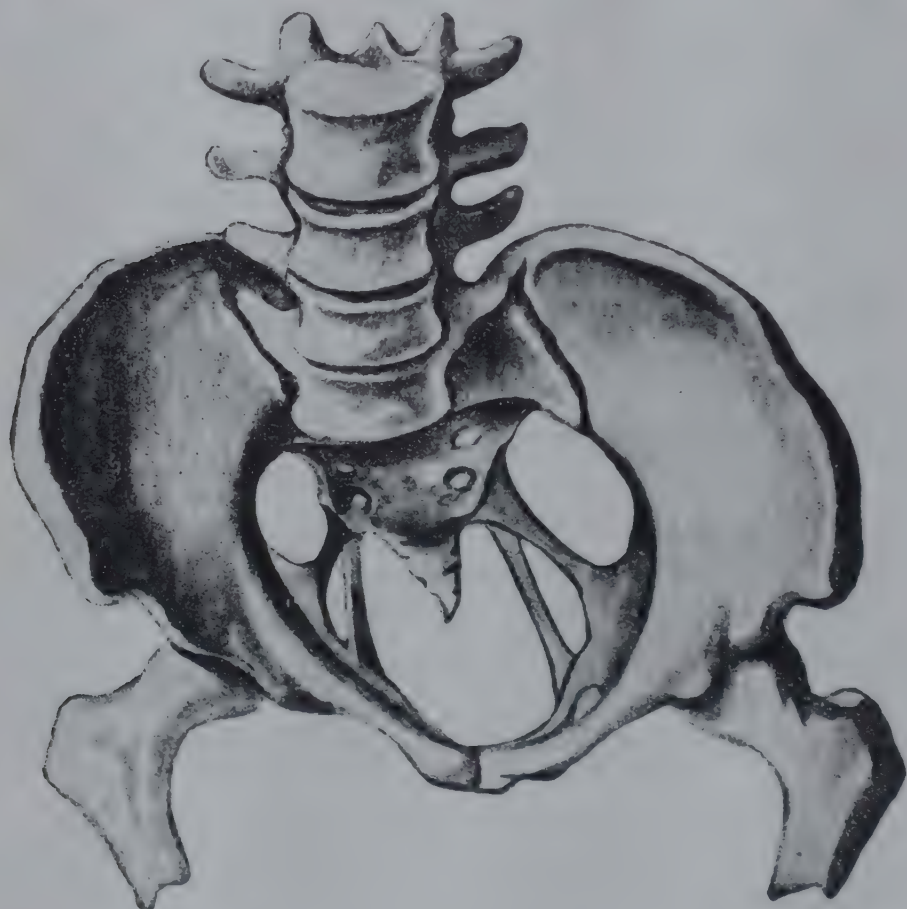


FIG. 125.—Obliquely contracted pelvis: Nægele's.

ing of the subpubic angle exists the head fails to engage and cæsarean section is the only safe method of delivery.

The Platypelloid Type. Here the foetal head must engage in the transverse diameter of the pelvic inlet. Unless the subpubic angle is narrow, the transverse diameter is the longest diameter throughout the pelvis. The head should be allowed to descend in this diameter to the pelvic floor. If assistance by forceps becomes necessary, rotation must not be attempted until the head has descended sufficiently and is low down near the outlet. Two possible injuries may result in the course of the delivery if the long diameter of the foetal head does not descend in the transverse diameter but is forced into the antero-

posterior diameter, viz., serious intracranial injury to the child or separation of the symphysis.

Many varieties of contracted pelvis have been identified and described in detail including the mechanism of labour in those types and their management. It is fortunate that in modern obstetrics such types have become a rarity. Hence it is not deemed necessary to describe these pelvises in detail.

One occasionally encounters an obliquely contracted pelvis more commonly the result of poliomyelitis or injuries rather than from developmental defects where one ala of the sacrum is absent (Nægale's pelvis). The extreme degree of contraction resulting from



FIG. 126.—Triradiate Pelvis.

rickets or osteomalacia—the so-called triradiate pelvis is now seldom met with. When scoliosis or kyphosis involve the lumbo-sacral region the pelvis is again likely to be affected.

When clinical and radiological examination reveals any pelvic distortion of significant degree cæsarean section is the only safe method of delivery for mother and child though with mild degrees of oblique contraction vaginal delivery may be possible. In fact in the triradiate pelvis with its characteristic picture at times the contraction may be such that the only safe method of delivery for the mother would be by cæsarean section even if the fœtus is dead.

COMPLICATIONS OF THE THIRD STAGE OF LABOUR

Post-partum Hæmorrhage. Hæmorrhage occurring after the delivery of the child is termed post-partum hæmorrhage. It includes third stage bleeding, i.e., bleeding occurring after the birth of the child but prior to the expulsion of the placenta. Secondary post-partum hæmorrhage is that occurring any time after twenty-four hours of delivery.

Primary Post-partum Hæmorrhage. Primary post-partum hæmorrhage is defined as loss of 500 ml. or more of blood. This definition, while satisfactory from the point of view of obtaining comparative statistics, is not wholly acceptable from the clinical point of view. In many women, even losses much less than 500 ml. lead to deterioration of their general clinical condition as shown by drop in blood pressure and rise in pulse rate. Patients with anæmia cannot afford to lose even the normal amounts, and hence, even with losses of less than 150 ml., sometimes these patients require the same treatment as those with blood loss of over 500 ml. The average amount of blood loss in normal labour varies. Ordinarily, it is between 115 and 230 ml. in our experience.

There are two varieties of primary post-partum hæmorrhage: (1) atonic and (2) traumatic. Atonic hæmorrhage is from the placental site and is due to the failure of the uterus to adequately contract and retract. Traumatic hæmorrhage is due to maternal injuries sustained in labour.

Causes of Atonic Hæmorrhage. Any factor which prevents proper contraction and retraction of the uterus may predispose to atonic hæmorrhage. Thus the predisposing factors are: (1) General malnutrition and anæmia, (2) Overdistension of the uterus as in multiple pregnancy, and hydramnios, (3) Fibroids of the uterus which interfere with proper contraction and retraction, (4) Multiparity, (5) Ante-partum hæmorrhage, (6) Prolonged labour leading to uterine exhaustion, (7) Deep anæsthesia or even heavy sedation in labour which interferes with proper contraction and retraction of the uterus, (8) Precipitate labour.

One of the prolific causes of post-partum hæmorrhage is mismanagement of the third stage of labour. Unnecessary massage and compression of the uterus to express an unseparated placenta often

results in hæmorrhage and shock. When a placenta is not separated there is seldom any bleeding. Bleeding usually occurs only after partial separation. A bleeding diathesis, such as thrombocytopenic purpura, is infrequently met with as a cause of post-partum hæmorrhage. In addition to all those enumerated above, there are quite a significant number of cases wherein no ætiological factor can be found. The mode of separation of the placenta may also play an important part in determining the blood loss in the third stage. Atonic forms of hæmorrhage may occur in cases of placenta prævia and also in cases of premature separation. Coagulation defects may also give rise to post-partum hæmorrhage.

Clinical Features. These necessarily depend upon the patient's general condition and the amount of blood loss. The bleeding occurs more often before the expulsion of the placenta than after, but third stage bleeding may be followed by true post-partum hæmorrhage. The bleeding may be in the form of a steady continuous trickle or a gush. Occasionally, the external bleeding may be slight but the uterus may become distended with blood and clots. In all cases, the general signs of hæmorrhage become progressively manifest—increasing pulse rate, increasing pallor, drop in blood pressure, restlessness, faintness, sweating and air hunger. The patient is anxious, complains of thirst and in extreme cases she quickly sinks into a condition of syncope with shallow respiration and death may supervene if timely aid is not given.

Side by side with these, if the placenta has been expelled, the uterus will be found flabby and enlarged often reaching above the umbilicus. At times, the enlarged flabby uterus falls backward, so that, especially in women with fat abdominal wall, it may be difficult even to feel the uterus.

Prognosis. 'In modern obstetrics no woman should die from post-partum hæmorrhage' (Eastman 1950). Yet, in the last five years, among 356 maternal deaths, excluding those due to associated causes, there were 40 deaths from post-partum hæmorrhage accounting for 11.2% of maternal deaths. Most of these deaths have been among those brought into hospital after having delivered elsewhere, placenta retained and having bled profusely prior to admission. Fatal post-partum hæmorrhage is rarely due to sudden massive bleeding. The outcome therefore depends on the care with which the delivery is conducted, the watchfulness of the obstetrician, and the speed and intensiveness of effective treatment adopted.

Diagnosis. Diagnosis presents little or no difficulty in the large majority of cases. It is necessary to differentiate between the atonic form of post-partum hæmorrhage and the traumatic form. In the

former the uterus is large and flabby in the latter it is contracted and firm.

In traumatic hæmorrhage, examination by a speculum will reveal the presence of lacerations in the genital tract. At times trauma and atony may co-exist.

Treatment. Every attempt must be made to prevent or anticipate post-partum hæmorrhage.

Prophylaxis. Good antenatal and intranatal care will reduce the incidence of post-partum hæmorrhage considerably. In the antenatal period, the general nutrition of the patient should be improved and any persisting anæmia properly treated. All pregnant women must have their blood group determined and for those in whom post-partum hæmorrhage is anticipated, compatible blood should be available. Deep anæsthesia must be avoided, and wherever possible, operative deliveries, vaginal, should be under pudendal block anæsthesia. In the multiparæ, in those with hydramnios, multiple pregnancy, ante-partum hæmorrhage—in other words, in all in whom one may anticipate post-partum hæmorrhage, at the time of delivery of the anterior shoulder, 0.25 mgm. of Methergine should be given intravenously as a routine. This procedure helps in reducing considerably the amount of blood loss in the third stage. Hour-glass contraction leading to retention of the placenta necessitating manual removal is the disadvantage in this method. In our experience of over 500 cases, we have come across this complication only once. Another important form of prophylaxis is to avoid unnecessary manipulation of the uterus by massaging and squeezing it when the placenta is still *in utero* and is unseparated. Such procedures only tend to produce more shock and hæmorrhage.

Curative Treatment. The objective of treatment is to stop the bleeding and replace the blood lost.

If the bleeding starts with the placenta *in utero*, the fundus of the uterus must be grasped and massaged to make it contract. If the placenta shows signs of separation, it must be expressed by either Creede's method or by the now more commonly employed Brandt-Andrew technique. Methergine or Ergometrine 0.25 mgm. should be given intravenously at this stage and in the majority nothing more may be necessary. Arrangements for blood transfusion should be got under way.

If the placenta is not separated, no attempt should be made to express it by forcible methods. It is far better to give the patient 0.25 mgm. Methergine intravenously, and to remove it manually under light

anæsthesia, if the bleeding still persists. This is further discussed under 'retained placenta'.

When bleeding starts after expulsion of the placenta, the fundus should be firmly grasped and massaged and Methergine 0.25 mgm. given intravenously. The expressed placenta should be carefully inspected to see if it is entire. If any cotyledons or lobes are found missing, the uterine cavity should be explored. Meanwhile, blood transfusion should be started.

If the bleeding continues in spite of intravenous Methergine and the uterus shows a tendency to relax, it is a useful procedure to set up a drip containing 10 units of Oxytocin (Pitocin or Syntocinon) in 500 cc. of 5% glucose and run in the drip at a rate which keeps the uterus contracted. The setting up of the drip takes time. Meanwhile, if bleeding is profuse and is continuing—granting that traumatic hæmorrhage has been ruled out—to get immediate control, one could introduce the fist of one hand into the vagina, with the external hand get the fundus of the uterus anteflexed over the symphysis and thus compress it between the fist in the anterior fornix and the external hand over the fundus. This position is rather taxing and cannot be maintained for over 10-15 minutes. Methergine can be directly injected through the abdominal wall into the uterus. It is quite a useful procedure in these severe cases. Most of the cases respond to this line of management and, with sufficient amount of blood transfused, survive the hæmorrhage.

When, in a small minority, the hæmorrhage is still found persisting, traumatic factors must be considered and if tears of the cervix or vagina are found, they must be sutured. In their absence, with persistent bleeding, the management of these cases presents a problem. Intra-uterine packing has been advocated by some.

When bleeding continues in spite of all these, the obstetrician has to consider the question of hysterectomy. We have resorted to it only on very rare occasions in uncontrollable post-partum hæmorrhage in grand multiparæ. Of late instances have been reported where patients have been saved by ligation of the Internal Iliac arteries (instead of hysterectomy) in uncontrollable atonic post-partum hæmorrhage.

One cannot emphasize too strongly the necessity for adequate and timely blood transfusion. If these patients with severe hæmorrhage are to be saved, it is best to start the transfusion sufficiently early, rather than wait for them to collapse. In the worst cases the blood must be rushed in at a rapid rate. In fact, it is the availability of powerful oxytocic agents like Ergometrine and Methergine and blood transfusion that has completely altered the outlook in post-partum hæmorrhage.

Traumatic Hæmorrhage. This is usually due to trauma in labour. Apart from instrumental deliveries which are mostly responsible for traumatic hæmorrhage, it can also follow natural delivery. Perineal lacerations and episiotomy wounds can give rise to serious blood loss, as also vaginal lacerations. But the more common cause of profuse hæmorrhage is cervical lacerations, either resulting from operative deliveries or at times after natural deliveries. Tears in the region of the clitoris also give rise to profuse hæmorrhage.

The diagnosis is made on inspection after inserting a speculum. The hæmorrhage can be usually controlled by suturing the lacerations. Bleeding from vaginal lacerations, if they cannot be sutured, can be controlled by tight pack. Blood loss should be made up by adequate transfusion.

Secondary Post-partum Hæmorrhage. This is mostly due to retention of portions of the placenta or membranes. Occasionally, it may result from a cervical laceration. The hæmorrhage may occur at any time after 24 hours of delivery and may at times be alarming. The general condition of the patient will depend upon the amount of blood loss.

Treatment. The placenta and the membranes, after expulsion, should be carefully inspected. If any cotyledons are found missing; it is best to explore the uterus at this stage and remove them. Should however secondary post-partum hæmorrhage occur, the uterine cavity should be explored immediately after an intravenous injection of 0.25 mgm. of Methergine. Blood transfusion may be required in severe cases and instrumental dilatation of the cervix may be required to explore the uterus in those with a closed cervix. Digital exploration will help to remove the retained products. Infection should be guarded against by using antibiotics.

Retained and Adherent Placenta. The placenta separates from the uterine cavity within a few minutes of the birth of the child and it is expelled within 15-20 minutes or even much earlier. In fact, radiological evidence shows that the separation begins even as the head is being delivered and what were originally considered as signs of placental separation are really signs of descent. In other words, the placenta separates soon after the birth of the child but descends into the lower uterine segment and vagina a little later. While in the majority the separation and expulsion are completed from within a few minutes to half an hour, in some this time interval is prolonged. A placenta is then said to be retained, if it is not separated, and expelled within half to one hour of delivery of the baby.

Aetiological Factors. One of the most important factors in the separation and expulsion of the placenta is effective uterine contraction and retraction. Of these, retraction is more important. Anything which interferes with such proper contraction and retraction may give rise to retention of the placenta. To this the term 'atonic non-detachment' is applied. The second important factor is abnormalities in implantation of the placenta. Ordinarily the placenta is so implanted that separation through the spongy layer of the decidua is easily brought about. At times, as a result of infection and inflammation, there may be adhesions at the site of implantation when the non-separation and expulsion is due to 'adherent placenta'. Abnormalities in implantation may result in deeper penetration of the musculature by the trophoblast and this again gives rise to pathological conditions like placenta accreta and increta.

(I) Atonic non-detachment may be the result of (*a*) overdistention of the uterus due to twins, or hydramnios (*b*) exhaustion of uterine musculature as in prolonged labour, uterine inertia (*c*) inefficient uterine contractions due to the presence of fibroids, or multiparity and (*d*) any other factors interfering with efficient retraction of the uterus.

(II) Adherent placenta may result from endometritis or abnormalities of implantation and development—as in placenta accreta, succenturiata, membranacea.

(III) Retention may also be due to irregular uterine spasm due to the use of oxytocics or injudicious management of the third stage—unnecessary manipulation of the uterus.

Clinical Features. A placenta which is not expelled in the usual time is always a source of danger. The first and greatest danger is hæmorrhage. This hæmorrhage may be a severe, sudden bout or what is more common, a continuous steady trickle of blood. In either case, the result is profound, sudden collapse in the former and gradual onset of shock and collapse in the latter. The hæmorrhage takes place only when the placenta is at least partially separated. If it is totally adherent and not separated at any site, there is very little bleeding. The second danger, even in the absence of hæmorrhage, is shock. Sheehan demonstrated that the majority of patients in whom the placenta was retained for over two hours went into a state of shock—not due to hæmorrhage—from which a significant number died. The causation of such shock in the absence of hæmorrhage is ill-understood. It is possible that it may be due to the absorption of histamine-like substances from the placental site. The third danger is infection. The longer the placenta remains *in utero*, the greater are the chances

of infection. And lastly, there is the not very uncommon complication of fibrinogenopænia and hæmorrhage which is more common with a dead fœtus and retained placenta. Later in the puerperium, if small bits of placenta have been retained, secondary post-partum hæmorrhage, infection and subinvolution are the sequelæ. All these factors must be clearly borne in mind in deciding on the line of management of a case of retained placenta.

Management. (1) When a placenta is not expelled within 15-20 minutes after delivery, there is no bleeding and the signs of placental separation and descent are not evident, the patient should be kept under careful observation. Her pulse and blood pressure should be recorded. A hand may be placed on the abdomen behind the fundus of the uterus. No unnecessary stimulation or massage of the uterus should be done by this hand. It is kept there only to take control of the uterus if a necessity arises. In the absence of bleeding and non-separation of the placenta nothing further need be done for half to one hour. This time is utilised in getting compatible blood and a set-up for transfusion, should the necessity arise. At the end of one hour or even half an hour if still there are no signs of placental separation, even in the absence of bleeding, with the patient in good condition, we are in favour of removing the placenta manually. Whenever signs of separation are evident during this period, the placenta must be expressed. In the absence of any signs of separation, expression of the placenta is inadvisable. Manual removal under modern conditions is safer and hence Creede's expression is best avoided. Prior to manual removal, an intravenous injection of 0.25 mgm. of Methergine will help the separation and control of any hæmorrhage.

(2) If the placenta is retained and there is hæmorrhage, the hand over the uterus now makes the uterus contract by massaging it. An intravenous injection of 0.25 mgm. of Methergine or Ergometrine is given. This might control the bleeding and separate the placenta, in which case it is expressed. If it is not separated and bleeding continues, immediate manual removal under anæsthesia is carried out. While getting ready for manual removal, the uterus must be kept contracted by massaging it.

(3) As stated before, sometimes, even in the absence of bleeding, these patients go into a state of shock. This seldom happens if the placenta has been removed within one hour of delivery. When a patient is seen, after shock has set in, with the placenta not separated and with no bleeding, the treatment should be aimed at first to combat the shock. Pethidine 100 mg. is given as sedative. Immediate blood transfusion with compatible blood is started and the patient kept warm. Blood pressure and pulse are recorded. The cord is cut

short near the vulval outlet and sterile pad applied. With this line of management she usually rallies round. After she has rallied round from the shock, as judged by the blood pressure and pulse, the placenta should be manually removed, if it has not separated to enable expression.

Should however, at any time, hæmorrhage takes place, in spite of the shock the patient is in, immediate manual removal, combined with treatment of the shock by blood transfusion offers the only hope for the patient, if the placenta could not be expressed.

When retention is due to hour-glass contraction, in the absence of hæmorrhage, it is suggested that time be given for the spasm to pass off when the placenta can be expressed or more easily removed manually. If hæmorrhage indicates interference, under anæsthesia, it would be possible to remove the placenta manually.

Infected Retained Placenta. Sometimes patients are seen with frank infection and retained placenta. This happens more commonly in premature births with macerated fœtuses. In the absence of hæmorrhage the infection should be controlled with antibiotics. After it is controlled and temperature has been normal for a week, the uterus should be emptied by surgical methods. When hæmorrhage occurs, in spite of the infection, the uterus will have to be emptied—usually by digital evacuation if it cannot be expressed. Sometimes, by the time the infection is controlled, the placenta is spontaneously expelled.

Adherent Placenta. A placenta may be adherent partially or completely, lightly or densely. Partial adherence is often associated with partial separation and hence with bleeding in the third stage. A completely adherent placenta does not give rise to bleeding and should be suspected, when a well contracted uterus with a non-separated retained placenta and no bleeding is encountered. These morbid adhesions may result from previous infection which might have resulted from an intra-uterine manipulation at a previous delivery. In fact, some of these patients give a history of repeated manual removals in previous pregnancies. The treatment in these cases is manual removal. Lightly adherent placenta can be easily removed. One must work carefully and gently along the plane of cleavage with the external hand steadying the uterus and pressing it down. The placenta must be removed *en masse* and not piecemeal. This may sometimes be very difficult in cases of densely adherent placentæ. The tendency for hæmorrhage should be controlled by intravenous Methergine and antibiotics should be given to control infection. Shock sometimes follows this operation. Facilities for blood transfusion should be available before attempting removal.

Retained Cotyledons. When a placenta is expelled, it should be carefully inspected. If any cotyledon is found missing, it is best to explore the uterus and remove it. Even in the absence of bleeding,



FIG. 127.—Third stage of labour.

Hour-glass contraction of the uterus with retained placenta.
Method of manual removal of placenta.

it is better to remove it, as otherwise, it is likely at a later stage to give rise to secondary post-partum hæmorrhage, infection and subinvolution in the puerperium.

Retained or Adherent Membranes

Not infrequently a portion of the membranes is left in the uterus, and in some cases the whole chorion may be adherent. This may cause hæmorrhage and later lead to infection.

The diagnosis is usually made by a careful examination of the placenta and the membranes after delivery.

Treatment. Small pieces of retained chorion do not require removal in the absence of any hæmorrhage and if the uterus is properly contracted. Injudicious attempts at removal by intra-uterine manipulation may only favour sepsis. The fragments of membrane are

generally discharged in the lochia, and this is facilitated by administering oxytocics in the puerperium.

Placenta Accreta. Placenta accreta has been defined as the abnormal adherence either in whole or in part of the after-birth to the underlying uterine wall. Pathologically, there may be demonstrated a complete or partial absence of the decidua basalis, specifically, the spongiosa, placing the trophoblast in direct contact with the subjacent myometrium. Placenta accreta may be total, involving the entire placenta, partial, involving one or more cotyledons, and focal, involving part of a single cotyledon.

If the trophoblast has invaded the myometrium, the condition is known as placenta increta; and if uterine perforation appears, the condition is known as placenta percreta.

The incidence of placenta accreta varies widely depending upon whether adherent placenta are routinely submitted for histological examination. Sometimes placenta accreta complicates placenta praevia.

The basic cause of placenta accreta is decidual deficiency. In certain cases, a previous history of intra-uterine manipulation, such as manual removal of placenta, curettage, use of abortive agents and uterine infection, may be obtained.

Treatment. Placenta accreta is usually diagnosed only when attempts at manual removal are made. These efforts result in a failure to find the place of cleavage in a totally adherent placenta. When the placenta is accreta, in a multipara, hysterectomy would be the better line of treatment, if the patient can stand the operation. The danger of leaving it alone is infection. With antibiotic therapy, cases are on record where the placenta has been left *in utero* with the hope of it being autolysed and destroyed. We have also done it on three occasions in primigravidae. Though all of them survived, in two, severe infection set in. These latter developed peritonitis, pelvic thrombophlebitis, pyaemic abscess of the lung, but somehow they ultimately survived. Except in primigravidae, we are more in favour of hysterectomy in these cases. Needless to state that all facilities to control shock must be available before resorting to it. If only a small number of lobes are retained, due to their being accreta, while the major portion of the placenta has been removed, the patient may be left alone. Infection should be guarded against by proper antibiotic therapy.

The advent of antibiotics and blood transfusion has completely revolutionised the management of the retained placenta. Prior to this era, manual removal was avoided, except when forced to do it because of

the dangers from shock and infection. Hence a retained placenta was left alone for days together in the hope that it will be expelled some time later. Hæmorrhage was the only indication for interference and, even here, Creede's expression was used to the maximum which in many cases added more shock. During the years 1934-1938 in the Madras Government Hospital for Women and Children there were 124 cases of manual removal among 19,056 deliveries with a 19.3% mortality. During 1959 and 1960, among 25,804 deliveries, there were 256 cases of manual removal with a mortality rate of 1.6%. These deaths were in patients brought in from outside after severe hæmorrhage. This indicates the change in the management of these cases. Whenever vaginal operative deliveries are done under anæsthesia, we do not wait for the conventional one hour for removal of the placenta. If the placenta has not separated within 10 minutes, it is usually removed manually. In all cases, 0.25 mgm. Methergine should be administered intravenously prior to manual removal.

The safety afforded to major operative procedures in obstetrics under modern conditions should not be made the excuse for unnecessary manual removal. It should be resorted to, only on indication and on sound established principles. We are strongly against routine manual removal of the placenta as recommended by some.

Sequelæ of Adherent or Retained Placenta. The following sequelæ may occur in this condition :—

- (1) Puerperal infection.
- (2) Subinvolution of the uterus.
- (3) Secondary post-partum hæmorrhage.
- (4) The formation of a placental polypus.

Puerperal infection, the result of retained or adherent placenta, is usually due to infection from without, favoured by the lowered vitality of the patient resulting from hæmorrhage and the presence of the degenerating placental tissue. For these reasons strict aseptic and antiseptic care must be taken when removing the placenta manually.

Subinvolution of the uterus is not infrequent partly on account of retention of some portion of the membranes or placenta, and partly due to the anæmic condition of the patient following post-partum hæmorrhage. Antibiotics and treatment of anæmia will often cure the condition.

Secondary post-partum hæmorrhage. This condition is dealt with in the chapter on post-partum hæmorrhage.

Placental polypus. This is another of the sequelæ of retention of small portions of placenta and particularly of a succenturiate lobe. A piece of placenta remains adherent to the uterine wall, and by the gradual deposition of blood-clot over its surface it increases in size, and the uterus fails to involute completely. Contractions of the uterus gradually expel the placental polypus through the cervix which remains patent.

The chief symptom is hæmorrhage which occurs at a rather late period of the puerperium. There may be a slight rise of temperature ; sometimes the placental polypus may be retained in the uterus for weeks or even months, and this is associated with persistent and intractable metrorrhagia and an offensive dirty vaginal discharge.

The diagnosis is made from the history, increased size of the uterus, and the nature of the vaginal hæmorrhage.

Treatment. Consists in dilating the cervical canal and removing the polypus and curetting the uterine cavity.

Puerperal Inversion of the Uterus

Inversion of the uterus, by which is meant the uterus being turned inside out, may occur immediately after delivery :—

Aetiology. The factors that favour inversion are :—

- (1) Atony of the uterus.
- (2) Improperly applied pressured over the fundus.
- (3) Traction on the umbilical cord.
- (4) Fundal implantation of the placenta.

Inversion is brought about either by pressure from above or by traction from below, in the presence of an atonic uterus and a soft dilated os. Excessive force used in the expression of the placenta, especially when the uterus is atonic is a common cause of inversion. Occasionally, at the end of the second stage, forcible attempts to express the fœtus may cause a slight dimpling of the fundus, which, together with the straining and subsequent uterine contractions, may increase this dimple leading to inversion. In some cases faulty compression of the uterus, after expulsion of the placenta to arrest hæmorrhage or to express blood-clots, may similarly favour inversion. Traction on the cord before complete separation of the placenta and unskilful attempts at manual removal of the placenta may also cause inversion.

Varieties. Inversion of uterus may be of three degrees :—

First Degree : There is a dimpling of the fundus, which, however, still remains above the internal os.

Second Degree : The fundus passes through the internal os.

Third Degree : The uterus is completely turned inside out and lies partly outside the vulva.

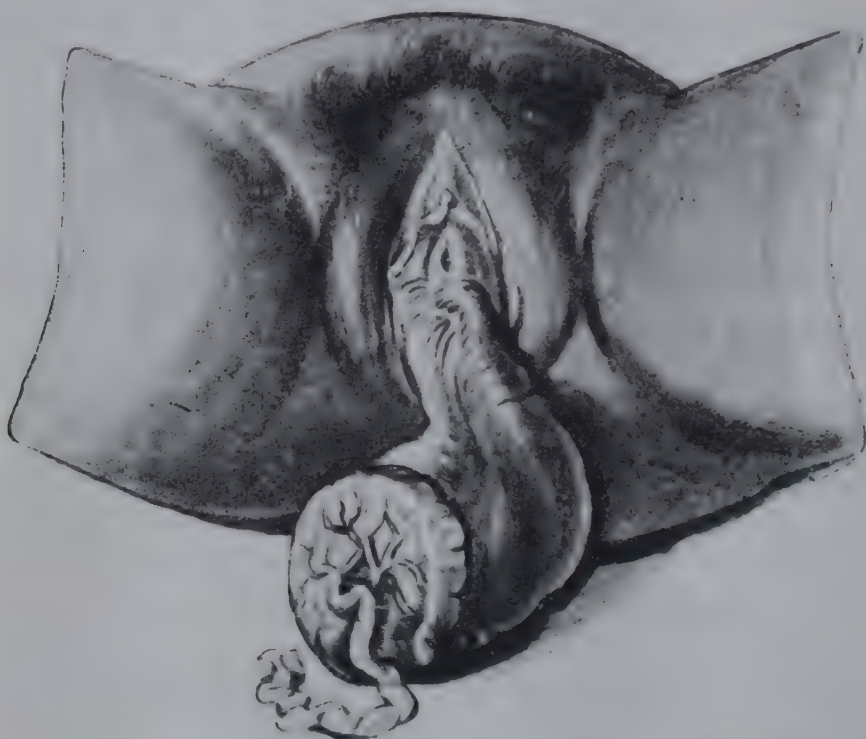


FIG. 128.—Complete inversion of the uterus.
The placenta is still adherent to the uterus.

Symptoms. Acute puerperal inversion of the uterus is one of the most serious of obstetric complications. Two symptoms dominate the clinical picture—shock and hæmorrhage. The hæmorrhage is sometimes of an intractable nature and not till the inversion is reduced can it be controlled. Where the inversion is complete, the congested endometrium of the uterus, with or without the placenta attached, can be seen lying outside the vulva and is easily recognised.

Diagnosis. The incomplete forms of inversion present greater difficulties in diagnosis. In addition to the hæmorrhage and shock, abdominal palpation shows the fundus to be absent or deficient, with occasionally the presence of an actual dimple. Vaginal examination will reveal a soft, globular swelling in the vagina or cervical canal which, together with the fact that the fundus cannot be felt by abdominal palpation, at once suggests the diagnosis. In the differential diagnosis of this condition, fibroid polypi, prolapse of the uterus with atonic hæmorrhage should be considered. A careful bimanual examination will easily help to differentiate these conditions.

Prognosis. The prognosis of this condition is grave, although with efficient help at hand to apply energetic treatment, the mortality may be considerably reduced. The shock and collapse associated with inversion are out of all proportion to the hæmorrhagic loss. Death is due to shock, hæmorrhage or sepsis.

Prophylaxis. Every effort should be made to prevent its occurrence by care in the conduct of the third stage of labour. This consists in strictly avoiding any traction on the cord or applying unskilful pressure to the fundus of the uterus and forcible expression of a non-separated placenta.

Treatment. An inverted uterus must immediately be replaced. This should be done preferably under anæsthesia, but even if an anæsthetic is not available, there should be no delay in attempting to replace the uterus. The principle to be borne in mind in replacing an inverted uterus is that the portion that came down last should be replaced first; and, as generally a portion of the cervical canal is the last to come down, it should be replaced first, and the fundal portion should be the last. As a matter of fact, in the majority of cases, during the replacement of an inverted uterus, the fundal portion flops back into position once the greater part of the inverted uterus has been replaced. The replacement is effected by steady, firm pressure exerted by the fingers. The other hand should be on the abdomen to support the uterus as it is being replaced. After reposition, the fundus should be massaged carefully, uterine contractions promoted, and the patient treated for shock and collapse.

In case the patient is in deep shock, immediate attempt to replace the uterus may turn the tide against her. In such cases, it is better to replace the fundus in the vagina, pack the vagina with antiseptic gauze and treat the patient for shock and collapse with blood transfusion and morphia. If bleeding however is free, it is necessary to take immediate steps to replace the uterus risking the added shock that may supervene.

Should the placenta, if attached to an inverted uterus, be removed before reposition? This is a point on which opinions differ. The advantage of removing the placenta before reposition is that it is easily and thoroughly done under direct vision and the mass to be replaced is thereby reduced in size, but the disadvantage is that a severe hæmorrhage may occur which cannot be controlled till the uterus has been reposed. If there is difficulty in reducing the inversion, under such circumstances, it necessarily follows that the patient runs a serious risk. *Per contra*, while there may be some difficulty in removing the placenta after reposition, the advantage claimed is that the uterus is much more under control if post-partum hæmorrhage should supervene.

We are inclined to favour the view that it is preferable to remove the placenta after reposition of the inverted uterus, in favourable cases. Should there be any likelihood of difficulty, it is best to remove the placenta before reposition.

If the patient is seen a day or two after the accident, the choice lies between placing the inversion within the vagina, improving her general health and controlling infection by antibiotics or replacing it by abdominal operation. With the safety afforded to surgery now, many recommend laparotomy and replacement of inversion by any of the various operative procedures. The simplest of them is that known after Huntingdon and Kellog, wherein reposition is effected by traction with Allis's forceps of the inverted uterus after laparotomy. Failing this Haultain's or Dobbin's operation may be performed. The last two operations are usually advocated for chronic inversion.

Aveling's repositor has also been successfully used in the management of subacute and chronic inversions.

Chronic Puerperal Inversion. In some cases inversion may not be recognised at the time of its occurrence, or the patient may only be seen for the first time some days later. In such cases, the patient suffers from repeated hæmorrhages and a slight rise of temperature. The endometrium being exposed, presents a granular, shaggy appearance due to the chronic congestion and infection, particularly over the placental site. The condition is recognised on a vaginal examination which reveals the presence of a globular swelling, with the soft thickened endometrium presenting a hyperæmic appearance when seen with a speculum.

Diagnosis. It is very often confused with prolapse of the uterus or a fibroid polypus.

The globular nature of the mass, with its velvety surface, the absence of the external os at its lower end, and the presence of the ring of the dilated cervical canal above the mass, will help to differentiate inversion from prolapse of the uterus.

A fibroid polypus may easily be mistaken for inversion of the uterus; but on bimanual examination, the fundus of the uterus is palpable in its normal position. A careful vaginal examination with the finger introduced into the cervical canal, if possible, will help to differentiate the condition. A fibroid polypus is harder and does not present the same soft, velvety feel of an inverted uterus. If a uterine sound is passed, the normal or increased length of the uterine cavity can be demonstrated, together with the pedicle of the fibroid polypus, whereas in the case of an inverted uterus the sound passes less than the normal distance.

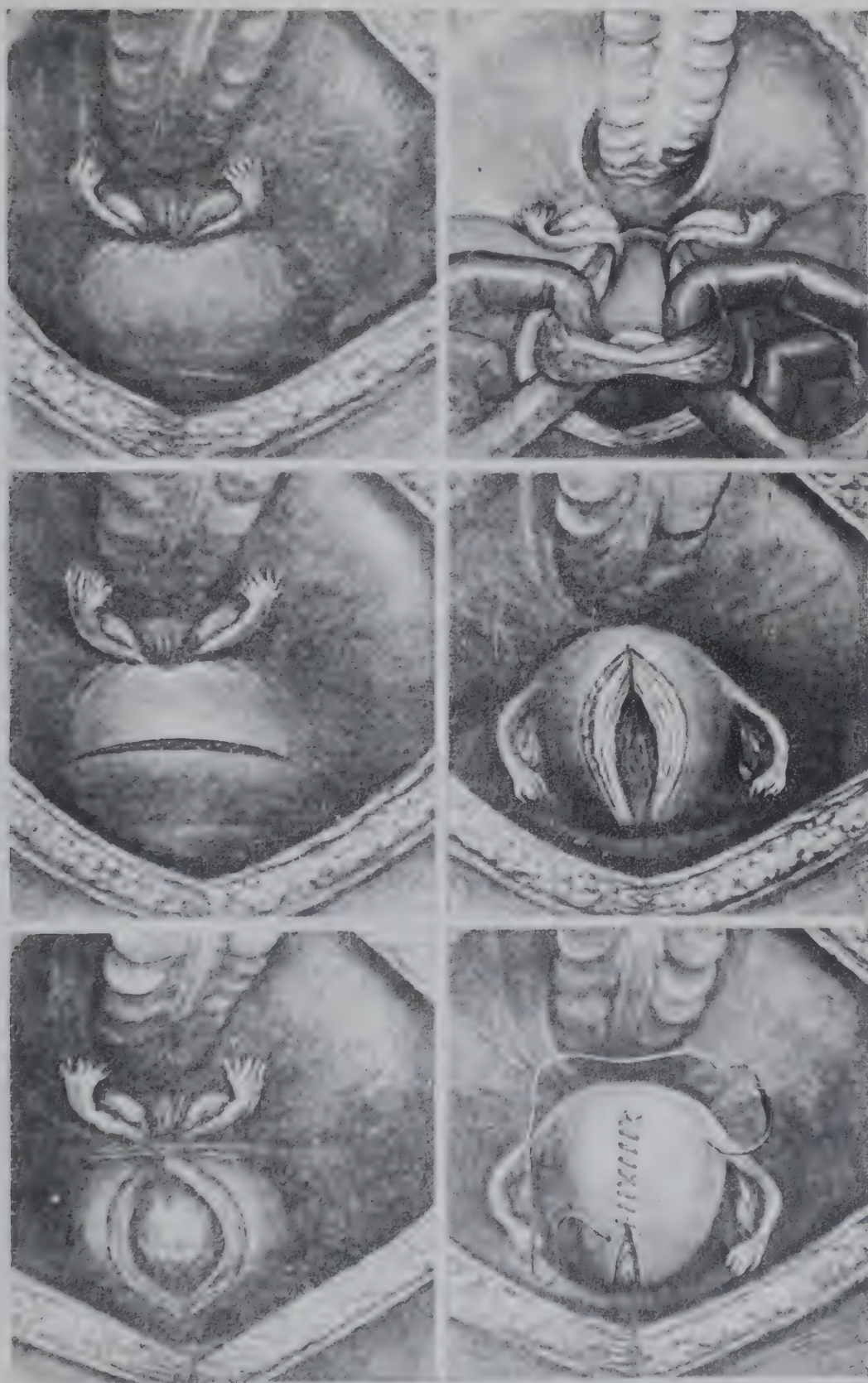


FIG. 129.—Inversion of the uterus, showing the steps of the operation in the reduction of the inversion through the abdominal route.

Treatment. The immediate treatment is to combat infection by antibiotics. Later an attempt may be made under an anæsthetic to replace the inverted uterus. If this proves unsuccessful, it is much better to improve the general condition of the patient and to treat her for the hæmorrhage and infection and only at the second or third month after delivery undertake an operation for the replacement of the inverted uterus.

The operation may either be by the vaginal route or the abdominal route. The classical operation described by Spinelli is done by the vaginal route. The technique of the operation is as follows: The vagina and the inverted uterus are carefully cleaned; the anterior fornix is incised and the bladder is separated from the uterus. The uterovesical peritoneal pouch is opened into and the inverted uterus exposed. The cervix is caught on either side of the median line by two volsella and is incised in the midline, the incision being continued down the anterior wall of the inverted corpus uteri sufficiently low to allow the inversion of the uterus to be reduced. The uterus is then replaced by grasping the sides of the incision with fingers of both hands and making pressure against the fundus with the thumbs. The incision in the uterus is closed by a layer of sutures, and the vaginal mucous membranes sutured.

An operation through the abdominal route is sometimes of great advantage, especially in those cases where the cervix is not within easy reach of the finger, and considerable difficulty is experienced in reaching the anterior fornix and separating the bladder. We have performed this operation on several occasions and the diagrams which give the detailed technique of the operation are given below.

INJURIES TO THE PARTURIENT CANAL

DURING the process of delivery the genital passages are stretched, and in the majority of cases of normal labour such stretching should not lead to any injury. But on account of various factors associated with the phenomena of labour, injuries are not uncommon, both in spontaneous as well as in assisted deliveries. The extent of such injuries depends upon the care exercised by the obstetrician and the skill with which the delivery is conducted.

Injuries to the parturient canal may broadly be classified under two heads :—

- (1) Injuries to the bony parts.
- (2) Injuries to the soft parts.

Injuries to the Bony Parts

Injury to the bony parts is extremely rare, but the following may be damaged :—

- (a) The symphysis pubis.
- (b) The sacro-coccygeal joint.
- (c) Occasionally the sacro-iliac synchondroses.

Injury to the Symphysis Pubis. This sometimes occurs spontaneously, but is more often produced during the forcible extraction of the head through the pelvic brim, either by forceps or in a breech delivery. When it occurs spontaneously, it is generally the result of strong uterine contractions driving the head suddenly through the pelvis. This accident is not generally serious, as it does not lead to wide separation of the pubic bones. The patient may complain of pain and tenderness over the symphysis pubis and a distinct gap is felt between the pubic bones.

In cases of assisted delivery, on the other hand, the damage is greater, as a wide separation of the symphysis pubis usually results, and is associated with serious injury to the soft parts. Such serious injuries result from injudicious traction with forceps and sometimes after symphysiotomy. The urethra and the bladder may be involved ;

the subjacent vessels may be injured and severe hæmorrhage may result. If there is a very wide separation of the bones, the sacro-iliac joints themselves may be affected. In the majority of cases, however, such serious damages do not occur.

Diagnosis. The patient gives a history of something having given way in a spontaneous delivery, or during an assisted labour, the operator can feel and sometimes hear the grating sound produced by the snapping of the cartilage. The gap between the pubic bones, the tenderness on pressure, and the pain felt more particularly on movement of the limbs, confirm the diagnosis.

Treatment consists in keeping the patient at rest on a firm bed with strips of adhesive plaster applied tightly round the whole pelvis so as to immobilise the joint. A firm binder around the pelvis may also be applied and this gives a feeling of security and comfort to the patient. In those cases where difficulty in micturition is experienced, care must be taken to see that the bladder is emptied with strict aseptic precautions. A self-retaining catheter may, with advantage, be left in for a few days. The patient may be allowed to move about after two or three weeks, and usually little discomfort is felt if treatment has been undertaken sufficiently early.

Fracture and Dislocation of the Coccyx. This injury generally occurs during extraction of the fœtus. It is more likely to occur in those cases where the subpubic angle is narrow, so that the head has to emerge more posteriorly at the outlet.

The injury may not be recognised till some months after delivery, when the patient will probably complain of pain in the lower part of the sacrum, particularly in the sitting posture. Palpation of the now unduly mobile or displaced coccyx will enable one to diagnose the condition. Occasionally, a persistent neuralgia is present and is known as coccydynia. If the pain is severe, it may be necessary to excise the coccyx.

Injuries to the Sacro-iliac Synchrondroses. These may result after symphysiotomy, pubiotomy or when the symphysis gives way spontaneously during the process of delivery. There is flaring out of the iliac bones and the ligaments of the joints are torn and so do not support the pelvic girdle. The patient is unable to use the limbs freely and complains of pain in the region of the sacrum.

Rest in bed, with proper support to the pelvis by strapping for two or three weeks, may be necessary, after which the patient may gradually be allowed to move about.

Injuries to the Soft Parts

Injuries to the Vulva. These are very common, and if a careful examination be made, slight tears of the labia minora, the fourchette, and sometimes the vestibule, may be detected. The lacerations are generally slight and may not require any treatment. Sometimes, however, it is desirable to suture the tears with catgut.

Lacerations of the vestibule may, in some cases, give rise to severe hæmorrhage from injury to the vessels of the clitoris. The most efficient method of controlling such hæmorrhage is by a suture.

The perineum is the most common seat of a tear. The extent of the tear often depends upon the care taken and skill displayed during delivery of the head. The precautions to be taken to avoid such a tear have already been mentioned in dealing with the conduct of normal labour and the care of the perineum. It is important to recognise that every effort should be made to prevent a tear, in view both of the immediate and remote effects. A tear of the perineum, especially if it is fairly extensive, may result in infection of the genital tract owing to the proximity of the anus; and if such a tear be neglected, the weakness of the pelvic floor will gradually lead to utero-vaginal prolapse. In some cases, although the superficial skin may be intact, the deeper structures forming the pelvic floor are lacerated, giving rise to weakness of the pelvic floor in the same manner as if a tear of the perineum, involving skin, had occurred. In view of these facts it should be a general rule to examine the perineum carefully in every case of labour to see if there are any lacerations and, if present, carefully to suture the parts so as to reform the perineal body as efficiently as possible.

Four degrees of perineal laceration are described :—

- (1) A slight tear of the perineum, the tear involving only the fourchette and anterior margin of the perineum.
- (2) Lacerations reaching up to the margin of the anus but not involving the sphincter.
- (3) Complete laceration of the perineum, the tear extending to the rectum.
- (4) A central perineal tear which leaves the posterior commissure and the anterior margin of the perineum intact, but may involve the central portion of the perineum even up to or including the rectum.

Ætiology. The most common causes of perineal lacerations are :—

- (1) Disproportion between the fœtus and the soft parts. Generally it is due to a large head or an imperfectly flexed head, but in some

cases, particularly with anencephalic monsters and unduly large children, the head may not give the same amount of trouble as the shoulders, in the extraction of which the perineum may be badly lacerated.

(2) In some cases the vulval outlet itself may be very small, or the parts may be extremely rigid, as in elderly primiparæ.

(3) Too rapid a delivery, either spontaneous or assisted, may tear the perineum, by not allowing the vulva to stretch sufficiently before the head emerges. This is likely to occur in cases of rapid extraction of the after-coming head, and in forceps application where the head slips out suddenly, particularly in occipito-posterior positions.

(4) Diseases of the soft parts. Old perineal cicatrices, œdema of the soft parts, generally as a result of prolonged labour, or diseases such as infective granulomata and elephantoid conditions of the perineum predispose to lacerations.

(5) Narrow subpubic angle, by causing the head to emerge out more posteriorly, may cause undue stretching of the perineum and thus favour lacerations. In a contraction of the bony pelvic outlet, the perineal lacerations tend to be of the third degree.

Diagnosis. Perineal lacerations can easily be diagnosed by a careful local examination after delivery. It is necessary to examine the vulva in a good light, and to separate the labia to see to what extent the pelvic floor has been damaged, with or without involvement of the skin.

Treatment. *Prophylactic.* This has been discussed in the chapter on 'Conduct of normal labour.'

Curative. All tears of the perineum must be carefully sutured. In lacerations of the first degree a couple of catgut sutures to the vaginal mucous membranes may first be applied, so as to bring the edges into apposition, and then the skin with the whole thickness of the perineal body may be sutured up with silk, nylon or linen thread. If there is a clean tear of a minor degree, it is unnecessary to put in the vaginal catgut sutures. The whole thickness of the perineal body can be closely approximated by through-and-through perineal sutures.

Lacerations of the second and third degrees require much more thorough repair. The repair is best done after expulsion of the placenta and usually under local anæsthesia.

The patient is brought to the edge of the bed and placed in the lithotomy position. The area is cleaned and exposed to good light.

After thoroughly cleansing the wound and the adjoining surfaces, the area may be kept fairly dry by inserting a large sterile sponge into the vagina to prevent the flow of blood.

The levatores ani should be closely approximated; the vaginal tears should be sutured; if the rectum is involved, it should be re-formed carefully by suturing the anterior rectal wall; and lastly the skin edges should be brought into apposition. Catgut sutures are generally used for the deeper structures and nylon or linen thread for the skin.



FIG. 130.—Repair of a complete laceration of the perineum.

For proper union, the after-care of the case is all-important. The parts should be kept clean and dry. It is better in these cases not to allow the bowels to move for the first few days. Later, when the bowels are allowed to move, particular care should be taken to see that after each evacuation the perineum is thoroughly cleaned, dried, and a mild antiseptic applied. The patient is given light diet. On the fifth or sixth day, in cases of complete tear, the patient may be given a mild laxative. In some cases, where hard, scybalous masses are formed, it is desirable to inject an ounce or two of olive oil into the rectum, so as to soften the fæces, and follow this, if necessary, by a glycerine enema. Usually, the perineal sutures are removed by the seventh day. If these sutures are cutting through it is better to remove them

even earlier. If, however, the perineum has not united, and there is evidence of infection, one must face the inevitable necessity of removing the sutures so as to permit proper drainage. Healing occurs later by granulation.

Secondary Repair of the Perineum. This question sometimes arises in cases where the primary perineal repair is unsuccessful. Repair should be undertaken 10-12 weeks after delivery.

Central Perineal Rupture. This is a somewhat rare accident in precipitate labour. The head is driven down and, instead of the perineum tearing from the posterior commissure, the tissue gives way in the central portion midway between the rectum and the commissure. The head may then descend through this rent. Occasionally, when this occurs in an exaggerated form, the head has been seen to be delivered through the rectum.

In repairing this form of laceration where the rectum is involved, it is better to divide the narrow bridge between the laceration and the commissure, thus making it a complete tear before suturing.

If, however, the rectum is not involved it may, in some cases, be sufficient to suture the central tear in the perineum.

Where the perineal lacerations are associated with considerable œdema and bruising of the soft parts, it may not be desirable to suture the tear immediately after delivery for fear of infection and sloughing of the parts. In such cases the sutured perineum is not likely to heal and indeed the chances of infection are increased. Healing occurs by granulation and it is best, under such circumstances, to advise the patient to undergo a perineal repair at a later stage.

Lacerations of the Vagina. Lacerations of the vagina are not uncommon and more generally occur in forceps deliveries and breech extractions. They are more frequent where the head has to be rotated artificially and are severe if the forceps slip on traction. Sometimes vaginal tears are due to the symphysis pubis giving way or to the separation of the pubic bones in a pubiotomy. Such tears may involve the urethra and the bladder.

A more severe form of trauma may result after delivery in cases where the head has been jammed in the pelvis for a long time. In such cases the necrosis resulting from the prolonged pressure of the head and possible super-added infection may produce sloughs of the vagina which, when they separate, may lead to fistulous tracts communicating either with the bladder or with the rectum. Vaginal tears may be either longitudinal or transverse and when involving the

fornices may extend to the pelvic cellular space. The chief danger of vaginal tears is infection. Slight lacerations of the vagina do not require any particular treatment, but if there is an extensive tear it is necessary to suture it. There is usually an associated perineal tear and the repair of the vagina is combined with the perineal reconstruction.

Lacerations of the Cervix. The cervix after parturition is never the same as before. Minor lacerations occur in practically all cases. But deep tears are due to causes which are largely preventable.

The chief causes of cervical lacerations are:—

(1) Rapid delivery of the fœtus by natural powers or in assisted labour, when the cervix is not completely dilated. Thus in precipitate labour the cervix may be torn. More often, however, it is the accoucheur who is at fault. Serious injury to the cervix may occur by applying forceps when the cervix is not fully dilated or, by extracting a breech presentation with an imperfectly dilated cervix.

(2) Rigidity of the cervix. This may in some cases be due to natural causes. More often it is due to diseased conditions. In elderly primiparæ the cervix tends to be more rigid; in some cases, where the cervix has been lacerated previously or has been the seat of extensive operative procedure, the resulting scar may give rise to a rigidity which inevitably leads to a tear. If every case of labour is attended to with care and delivery attempted only after complete dilatation of the cervix, that is, after its effacement and retraction, serious lacerations will be less common.

Occasionally, the tear in the cervix may extend upwards and involve the lower uterine segment, opening up the pelvic cellular space and even the peritoneal cavity. These extensive tears will be more fully described under 'rupture of the uterus'.

A complication that may sometimes occur is a circular tear or 'avulsion of the cervix'. This may be due to a faulty application of the forceps where the cervix is caught between the blades and the head, so that when traction is applied a whole ring of the cervical tissue comes off. In some cases it may occur spontaneously when the uterus suddenly forces the head down.

Cervical tears are generally discovered after delivery as they cause hæmorrhage which may be profuse. Tears of the cervix are much more liable to occur in cases of placenta prævia, where owing to the low implantation of the placenta, the tissues are sodden and soft.

Prognosis. Small tears of the cervix usually heal without difficulty, but the risk of infection should always be borne in mind. Larger tears, may immediately give rise to severe hæmorrhage and later produce extensive scarring which extends to and involves the vaginal



FIG. 131.—Suturing of cervical tear after delivery.

vault. They lead to ectropion and persistent cervicitis. In some cases sterility, repeated abortions, premature labour or dystocia may occur as late sequelæ of old lacerations. When the tear extends into the parametrium, pelvic cellulitis and infection of the uterus and other complications may result.

Treatment. In minor tears not giving rise to any severe hæmorrhage no special treatment is indicated. Tears which give rise to significant hæmorrhage require suturing.

In such cases after inserting a posterior vaginal speculum the cervix should be held by a couple of sponge forceps. The two torn edges are brought into close apposition by means of interrupted catgut sutures, avoiding the endocervix.

It is desirable after a couple of weeks to examine the patient to see if healing has occurred, and if the cervical lacerations have not healed properly the patient should be advised to seek further treatment after three months.

Rupture of the Uterus

This is one of the most serious complications that may occur during pregnancy or in labour. In the majority of cases, the accident is due to neglect during labour. Efficient antenatal and intranatal care has almost eradicated such ruptures where skilled help is available to all. Instances of rupture, now occurring, are mainly in pregnancy following cæsarean section or spontaneous rupture in the grand multipara. With increasing popularity of planned families, the problem of the grand multiparæ is dying out so that in highly advanced countries the problem of uterine rupture is mainly confined to that occurring in pregnancy and labour following operations on the uterus—cæsarean section or myomectomy.

Incidence. The incidence of rupture varies according to the quality and degree of antenatal and intranatal care available to a community. In countries with efficient antenatal care, the reported incidence ranges from 1 in 4,461 to 1 in 1010. In the Government Maternity Hospital, Madras, among 78,008 deliveries, there were 164 cases of rupture of the uterus giving an incidence of 1 in 415.

Rupture of the uterus may occur during pregnancy or during labour. In labour it may occur during protracted and obstructed labour or sometimes it may occur during the course of a normal labour. Rupture occurring during a protracted obstructed labour is the most common type. Rupture may be the result of direct trauma or due to obstetric operations. It may also occur as a result of injudicious use of oxytocics. When it is not due to trauma it is termed spontaneous rupture and when rupture occurs in pregnancy it is often referred to as 'silent' rupture. A rupture is said to be complete when it involves all the three coats of the uterus, including the peritoneum. It is 'incomplete' when the peritoneal covering is intact. In a series of 164 ruptures there were 95 spontaneous, 31 traumatic and 38 scar ruptures.

Rupture of the Uterus during Pregnancy. In the vast majority of cases, rupture during pregnancy is the result of cæsarean section scar giving way. It is mostly situated in the upper segment, as, except occasionally, it is the classical cæsarean section scar that gives way in pregnancy much more commonly than the lower segment one. Rupture of myomectomy scars in pregnancy is said to be very uncommon. But of late a few cases have been reported wherein the scars of deep myomectomy have given way. Injury to the uterus during a previous confinement may sometimes produce a rupture of the uterus in succeeding pregnancy. A difficult manual removal of an adherent placenta may so weaken the uterine musculature that it gives way in a

succeeding pregnancy. The same may follow a very thorough curettage. An instance could be cited where the placenta perforated the wall of the uterus completely in late pregnancy in a patient who had previous manual removals. Perforation in pregnancy may also result from a malignant mole. Spontaneous rupture of the uterus in a woman of high parity may sometimes occur in pregnancy when it is usually fundal in situation. Apart from these, rupture has also been known to occur without any ascertainable cause.

Clinical Features. Rupture occurring in pregnancy presents features which are different from that occurring in labour. The signs and symptoms are sometimes so misleading and the whole process itself so insidious that it is termed 'silent rupture'. Mostly these cases of rupture are due to the giving way of a classical cæsarean section scar. These scars give way usually when the distension of the uterus is reaching its maximum and is most commonly encountered between 34 and 38 weeks. Occasionally it has occurred as early as the 20th week and also in labour. The patient in the early stages of commencing rupture complains of mild abdominal pains which is usually mistaken for labour pains. With rest, the pain is relieved to a certain extent. There may be at this stage slight increase in pulse rate and also exaggerated foetal movements. With further yielding of the scar, there is gradual trickling of blood into the peritoneal cavity, mild abdominal distension and sometimes vomiting. The foetal heart is irregular or absent at this stage. The amniotic sac containing the foetus next escapes into the peritoneal cavity and when it occurs the placenta also may separate and be expelled into the peritoneal cavity. At this stage the classical signs become evident—namely shock and collapse with signs of intraperitoneal hæmorrhage. The foetal parts are easily palpable per abdomen and the contracted uterus can be felt separately lying to one side. There may be some little vaginal bleeding but never profuse. At this stage there is no difficulty in diagnosis. This sequence of events is due to the mechanism of rupture in these cases, which is by the foetal sac herniating through the scar and the uterus retracting thereafter. There is little or no bleeding in this process and hence the absence of alarming symptoms. In quite a significant number, the placenta is implanted on the scar. In such cases not only is rupture of the scar more common but also bleeding is more profuse as the placenta perforates the scar. These ruptures are almost always complete. Occasionally, it may be incomplete. It may occur also with lower segment cæsarean scar but its rupture is more common in labour. Pronounced localised fullness and tenderness are the early symptoms. Suprapubic pain and bladder tenesmus are commonly present and blood is frequently found in a sample of the urine. The patient complains of ever-increasing constant pain in the lower abdomen and generally becomes pro-

gressively worse and collapses. The rupture of cæsarean scar is further discussed under labour following cæsarean section.

The Diagnosis. Watchful expectancy in pregnancy following a previous cæsarean section is very necessary—more so if it is a classical one. Careful attention should be paid to abdominal pain. Tenderness over the uterus, and slight abdominal distension with a small increase in pulse rate may be the earliest manifestation. When the fœtal heart is irregular or absent in association with the above findings, gradual disruption of the scar should be suspected. When complete rupture has taken place, the diagnosis presents no difficulty.

Treatment. Laparotomy with treatment of shock and hæmorrhage by blood transfusion is the line. On opening the abdomen the fœtus and placenta, which are usually lying free in the peritoneal cavity, are removed. Often there is plenty of blood in the peritoneal cavity but at times it is scanty. In a multigravida whose general condition is satisfactory hysterectomy is the procedure of choice. In the younger ones, where menstrual functions have to be preserved, the edges of the scar may be resected and the tear sutured in layers. Tubal sterilisation also should be done at the same time except on rare occasions in patients with no children and who are very anxious to have a baby. The danger of rupture in a succeeding pregnancy is great and this factor has to be taken into consideration in adopting a conservative method of treatment. We have on two occasions sutured the tear in the lower uterine segment and delivered these patients by elective cæsarean section at a subsequent pregnancy. We are however against risking a pregnancy in a patient who had a classical scar rupture.

We would like to draw attention to an early type of rupture of the classical scar with minimal signs and symptoms. In two instances the scar gave way gradually about the 24th week of pregnancy. It was so gradual that except for a little abdominal pain, which disappeared after a few days rest, the patients had no further trouble. They came into hospital three to four weeks later as no fœtal movements were felt and the uterus was not growing. 'Examination' revealed a secondary abdominal pregnancy resulting from the scar dehiscence some weeks ago. At laparotomy, the fœtus and placenta were found free in the peritoneal cavity. The classical section scar had given way in its entire length and there was very little blood in the peritoneal cavity in both instances. The patients made an uneventful recovery after hysterectomy.

Rupture of the Uterus after Protracted Labour. This is by far the commonest type of rupture. In our series of 164 cases there were 95 cases of rupture in labour. Of these, 64 occurred in protracted

obstructed labour and 31 during the course of a normal labour. The ætiological factors in these obstructed labours were as follows :

Contracted pelvis and cephalopelvic disproportion	35
Malpresentation	19
Cervical dystocia	2
Hydrocephalus	2
Grand multiparæ	6

It is evident that cephalopelvic disproportion and malpresentations are the most important ætiological factors. Among malpresentations, neglected shoulder presentations are notorious for causing rupture. So also are brow and mentoposterior positions. Obstruction due to tumours of the soft parts may give rise to rupture if not suitably treated.

The Mechanism of Rupture and Clinical Features

For a correct appreciation of the rupture of the uterus in protracted labour one must bear in mind the anatomical features of the

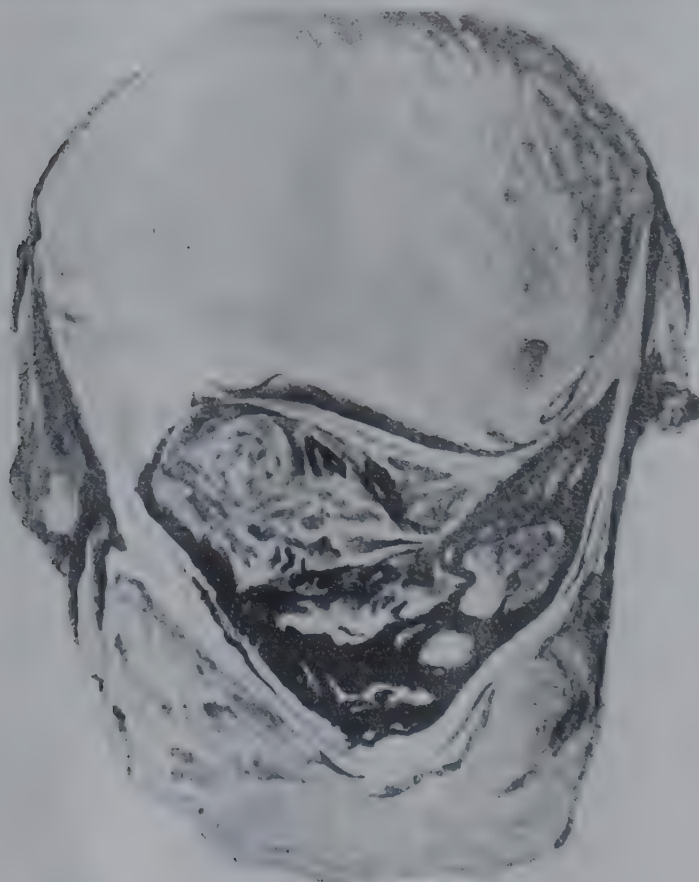


FIG. 132.—Ruptured uterus.

The tear is in the posterior wall of the lower uterine segment.

uterus during labour. The upper uterine segment contracts and retracts while the lower uterine segment dilates and stretches to accom-

moderate the descending fœtus. The demarcation between the upper and lower segments is a circular ring of muscle fibres, termed the retraction ring, which is seldom visible in ordinary labour. When, however, labour is obstructed and the upper segment continues to contract and retract, the lower segment becomes stretched vertically and thinned out. The retraction ring of Bandl is now seen over the front of the uterus, above the symphysis, running obliquely or transversely across. The longer the duration of the protracted labour, the higher the level of the ring in the abdomen. Above the ring is the retracting upper segment and below the stretched, thinned and dilated lower segment. The round ligaments are sometimes seen standing out on either side of the uterus. The upper uterine segment is hard and tender to touch having contracted down on the fœtus making palpation difficult. The fœtal heart is often absent or irregular and faint. The patient is anxious and in agony. She is exhausted, tongue is dry, pulse rapid. Vaginal examination reveals a hot dry vagina with a large caput on the presenting part. This stage is referred to as 'threatening rupture'. These are also the premonitory signs and symptoms of rupture. With further uterine contractions, the lower segment gets more thinned and stretched till ultimately at the height of a contraction it gives way. The rupture is incomplete to start with but becomes complete later when the fœtus and placenta escape into the peritoneal cavity.

When rupture takes place, the patient feels as if something has given way. She feels relieved for a time as all uterine action has ceased. But soon she collapses due to shock and hæmorrhage, signs of which are only too evident in typical cases. There may be at this stage some little vaginal bleeding but never profuse. The fœtal parts are very easily palpable and the contracted uterus felt to one side. The presenting part, if it has entered the pelvis, usually recedes. If the hæmorrhage is severe, there may be a shifting dullness. If no help is rendered at this stage, the patient usually dies of hæmorrhage and shock. If she survives it, she develops distension and peritonitis and may die of it, if adequate treatment is not available.

Rupture due to prolonged obstructed labour is almost always in



FIG. 133.—Ruptured lower segment due to congenital hypertrophic elongation of cervix.

the lower uterine segment which is the part which thins and stretches in labour. It may be longitudinal or oblique rent and may involve the uterine arteries which may prove fatal if immediate help is not available. At times, the rent may involve the bladder. It may also extend into the broad ligament giving rise to a broad ligament hæmatoma.

These ruptures may be complete or incomplete. The incomplete variety is difficult to diagnose as the uterine contour is still intact because of the fœtus being *in utero*. It would be wise to suspect incomplete rupture in all cases of threatened rupture and to rule it out after delivery. Often it is impossible to differentiate between incomplete rupture and tonically contracted uterus.

Diagnosis. A complete rupture of the uterus does not give rise to difficulty in diagnosis. The history of prolonged labour, the shocked and collapsed state of the patient with hardly recordable levels of blood pressure and rapid pulse, with the very easily palpable fœtal parts and absent contour of a pregnant uterus are diagnostic of the condition. We cannot but state here that while shock and collapse are invariably present in the majority, we have, on occasions, come across cases of complete rupture with minimal signs of shock and collapse, the patients having walked into hospital after rupture. Also in a grand multipara sometimes the fœtal parts are so very easily palpable as though they are just under the skin that it may be mistaken for a ruptured uterus, especially when the uterus is so much relaxed that its contour cannot be defined.

Incomplete rupture of the uterus has occasionally been mistaken for concealed accidental hæmorrhage. While the former occurs mostly in obstructed labour after hours of rupture of the membranes, concealed accidental hæmorrhage mostly occurs ante-partum so that a vaginal examination will help to differentiate the condition. In one, the signs of established labour are present, while in accidental hæmorrhage the cervix is usually closed and the patient is not in labour. Sometimes premature separation occurs during labour, when it becomes very difficult to differentiate it from incomplete rupture. The duration of labour, the presentation and position of the fœtus, and identification of any cause of obstruction in labour will help in arriving at a definite diagnosis.

The Treatment. *Prophylactic.*—Efficient antenatal and intranatal care can prevent rupture due to prolonged obstructed labour. Early diagnosis and proper management of cephalopelvic disproportion, malpresentation and other factors giving rise to obstruction will prevent rupture of the uterus. Extreme care should be taken in the

selection of cases for vaginal delivery after a previous cæsarean section. This aspect of the question is treated in a subsequent chapter on labour following cæsarean section.

If, however, the patient is seen in a state of impending or threatening rupture, immediate steps must be taken to empty the uterus by as conservative measures as possible. It is best to anæsthetise these patients immediately, even before a thorough examination is made, as continued contractions of the uterus will precipitate rupture. On occasions, the uterus ruptures by the time the examination is completed. Once the patient is anæsthetised and the uterine contractions abolished, a thorough general and obstetrical examination is made and steps taken to deliver the child by as conservative measures as possible, as also to treat the patient for shock and collapse which often follow delivery in these cases. It is desirable to start an intravenous drip of 5% glucose saline, prior to delivery, while simultaneous arrangements are made for compatible blood for transfusion if required. In neglected shoulder presentations—a very common cause for rupture of this type—the fœtus is delivered by decapitation or spondylotomy. A hydrocephalic head should be aspirated or perforated early in labour to avoid distension of the lower segment and consequent rupture. Cephalic presentations are delivered by forceps, and craniotomy if necessary, provided the head is not very high or at the brim. If it is too high and there is marked pelvic contractions, even if the child is dead cæsarean section under modern conditions may be safer to the mother. In all cases, after delivery and expulsion of the placenta, the uterine cavity must be explored for any evidence of rupture. If a rupture is found, it is dealt with immediately as discussed later.

At times, one faces the problem of an uncertain incomplete rupture. It was a routine to deliver these patients per vagina, explore the uterus and if a rent is discovered to deal with it later by laparotomy. Such procedures involved more shock. These patients are now dealt with a little differently. If an incomplete rupture is suspected, the patient is anæsthetised and laparotomy is performed. If no rupture is found, an assistant delivers the child from below if that is easily feasible—and the abdomen closed. If an incomplete rupture is found, the child is delivered *per vaginam*, if it can be easily done, or per abdomen, and the tear dealt with. This procedure gives rise to less shock and better results, though at times the laparotomy might be considered unnecessary. It is needless to emphasize that such procedures can be undertaken only when all facilities for major surgical procedures are available. The alternative is to complete the delivery *per vaginam* and, if an incomplete tear is found try conservative treatment by packing the uterus and vagina and treat the shock and infection that usually follow.

Treatment after Rupture. If rupture takes place in the hospital and is complete, the best line of treatment is immediate laparotomy with simultaneous treatment of shock and hæmorrhage by rapid and sufficient blood transfusion. After laparotomy the fœtus and placenta which are often lying free in the peritoneal cavity are removed. If the patient will stand it, total hysterectomy is the best procedure. Hysterectomy at times can be very difficult owing to complete distortion of the anatomy by hæmorrhage, lacerations and hæmatoma formation. The rent is always in the lower segment, mostly it is a ragged tear and often the broad ligaments are laid open by hæmatomata. Under these circumstances a hysterectomy through the tear may be all that is feasible. Sometimes the bladder is involved. This must be recognised and the tear in the bladder closed. On occasions the tear may have clear-cut edges which may justify suture of the rent and tubal sterilisation in a young patient. While hysterectomy is certainly the best procedure, it must be undertaken only in those who will stand the operation. The alternative is to excise the edges of the tear and suture them if it can be done. This operation is simpler and gives rise to much less shock and should be combined with tubal sterilisation. Broad spectrum antibiotic therapy to control post-operative peritonitis is essential. Enough blood must be transfused at operation to control the shock.

Treatment if seen Late after Rupture. Very often patients are brought into hospital after the uterus has ruptured some hours before. The immediate cause of death in these cases is shock and hæmorrhage. If the patient survives, gradual abdominal distension sets in and later peritonitis. The abdominal distension becomes marked within 8-10 hours of rupture. Most of these patients reach the hospital only after 3-4 hours of the accident and in the majority, the blood pressure and pulse cannot be recorded. It is our opinion that it is inadvisable to operate on these cases at this stage. We first try to rally the patient round by treating the shock with morphia, warmth and rapid and large blood transfusion. After she has rallied round which may take a few hours, a laparotomy is done and treatment is as for any other case of rupture. If, in spite of transfusion, she does not show satisfactory signs of improvement within a couple of hours, then she is submitted to laparotomy with simultaneous intensive treatment of shock and collapse. The prognosis in these cases is poor. It is inadvisable to wait too long. Once the abdominal distension has become prominent and established, the prognosis gets worse. It is better to get the systolic blood pressure raised to 90-100 mm. of Hg. in these cases before laparotomy. In our experience we have seen only on two occasions a bleeding vessel at the time of operation from the site of rupture. We believe that the patient having survived the initial hæmorrhage has better chances of survival if laparotomy is undertaken after she has been rallied round.

We do not think that blood transfusion in these cases prior to laparotomy would promote further internal hæmorrhage from the torn vessels.

Rupture Discovered After Delivery. If complete rupture is discovered on exploration of the uterus after delivery, the treatment advocated is the same as for rupture in labour, namely immediate laparotomy with simultaneous treatment of shock and collapse.

Incomplete Ruptures. These cases are mostly diagnosed only after delivery when the uterine cavity is explored. Treatment is the same as for rupture diagnosed after delivery.

If the patient's condition is unsatisfactory and no facilities exist for laparotomy the uterus and vagina are packed with gauze and the patient treated for shock and infection. The pack is gradually removed in 48-72 hours. If facilities are available, it is better to perform laparotomy even in incomplete ruptures.

Traumatic Ruptures. Direct trauma to the abdomen may occasionally cause rupture of the uterus in pregnancy. But of all types, obstetric trauma is an important cause of rupture. Of these, internal podalic version, done late in labour, is the most important. When forceps is applied prior to full dilatation and retraction, the cervical lips may tear during extraction and sometimes these tears extend into the lower uterine segment and may even involve the uterine arteries. At times they open up the broad ligament and produce big hæmatoma. The patient complains of tearing pain on one side and is disproportionately shocked and collapsed to the amount of external blood loss. In cases of difficult delivery it is better to explore the uterus to rule out any ruptures. The cervix is also inspected when there is any extra bleeding.

Treatment. Here again prophylaxis plays the most important part. Avoid internal podalic version, in patients where the membranes have ruptured some hours ago and all the liquor has drained away. Do not attempt internal podalic version when signs of threatened rupture are present. Oxytocin must be avoided when there is a tonically contracted uterus and in obstructed labour and, if used in labour, it is best to use it as a diluted intravenous drip.

Once the rupture is diagnosed, laparotomy with treatment of shock and collapse is indicated. An attempt may be made to suture the cervical lacerations per vagina, but if they extend too deeply into the lower segment, laparotomy may be necessary. At laparotomy, hysterectomy or suture of the tear may be done according to circumstances.

Rupture of the Uterus in Normal Labour. Rupture of the uterus in normal labour is uncommon except when the uterus is diseased. The common ætiological factors are (1) labour following a cæsarean section, (2) grand multiparity, and (3) trauma to the uterus as a result of previous intra-uterine manipulations—curettage or manual removal of adherent placenta. In these cases there is an acquired weakness of the uterine musculature which may give way even in a normal labour. Especially is this so in the grand multipara where with succeeding pregnancy more and more of the uterine muscle is replaced by fibrous tissue.

Apart from these it is not uncommon for uterine rupture to occur in women who are not grand multipara and in whom no obvious ætiological factors predisposing to rupture are evident. In fact as stated earlier there were among 164 cases, 31 cases where rupture occurred during the course of normal labour while patients were under observation. The ætiology of such rupture remains obscure.

Treatment. Rupture of the uterus is a grave and major obstetric problem—preventable to a very large extent. Once rupture has occurred, laparotomy with treatment of shock and hæmorrhage by blood transfusion is the treatment of choice. After laparotomy one could do a total hysterectomy, subtotal hysterectomy or suture of the rent with tubal sterilisation. In a multigravida, hysterectomy would be the line of choice. However, there may be occasions when a hysterectomy would be hazardous because of the patient's condition or there may be the necessity to conserve menstrual functions in a young girl. Suturing the tear and tubal sterilisation will satisfy the latter's requirements and it is also a procedure which involves much less shock than hysterectomy. The only disadvantage is that this unhealthy uterus at a later period may give rise to menstrual and other pelvic complaints. In a young woman with no live children the rent may be sutured without sterilizing her thus preserving her child bearing functions. When such a procedure is adopted expert care would be necessary in a subsequent pregnancy.

Colporrhexis. This is a form of rupture of the vaginal vault in labour exhibiting very much the same signs and symptoms of ruptured uterus. It is far less common than rupture of the uterus. In a series of 164 cases, there were 20 cases of Colporrhexis. The interesting feature of these cases is that rupture occurred in multiparæ with good obstetric record, labour proceeded normally but slowly, and by the time the head engaged and delivery could be effected, rupture had taken place. In all cases the cervix was almost fully dilated by the time the rupture took place and all of them had varying degrees of pelvic floor relaxation with rectocele and cystocele. It would appear that after

full cervical dilatation, when the vertex distends the vagina which has been rendered weak by repeated childbirth, the vault being the weakest portion gives way. Usually the posterior fornix being the weakest should give way more often. In a series of 20 cases the Colporrhexis was anterior in 12. It is possible that the degree of anterior or posterior segment weakness may be a determining factor.

The signs and symptoms are the same as in rupture of the uterus but the shock is often slower in onset and less severe. So also is the hæmorrhage. Often the fœtus and placenta escape into the peritoneal cavity and an engaged vertex may even recede from the cavity to the brim.

Treatment. Laparotomy, as in other cases of rupture of the uterus, is, in our experience, the method of choice. At times the colporrhexis is diagnosed after delivery *per vaginam*. We have not been able to suture the rent *per vaginam* successfully as recommended by some and hence we favour laparotomy and hysterectomy. At laparotomy it is seen that the cervico-vaginal junction has completely given way and the uterus could be seen attached to the vagina either posteriorly or anteriorly only. The bladder may be involved in anterior tears.

Maternal Mortality. 164 cases met with during a seven-year period were dealt with as follows: 12 mothers died soon after admission before anything could be done, i.e., within half to one hour. Of the remaining 152, 123 were dealt with by hysterectomy (74 total and 49 subtotal) and in 29 the rent was excised, sutured and in 27 tubal sterilisation also was done. Of these 152 cases, 16 mothers were lost—a mortality rate of 10.5%. We give below the type of treatment and results:

Type of treatment	Total hysterectomy	Subtotal hysterectomy	Suture of rent	Total
No. of cases	74	49	29	152
No. of deaths	9	7	Nil	16

We would invite attention to the 29 cases where the rent was sutured with no deaths.

It is well to operate under local anæsthesia in all these cases. Every attempt is to be made to avoid general anæsthesia. The value of blood transfusion and antibiotics is strikingly demonstrated by a comparative study of cases during a five-year period, 1934-1938, when the mortality for similar cases was 75%.

The Cause of Death. The commonest cause of death in these cases is shock and hæmorrhage. Next comes peritonitis. Prior to antibiotics and blood transfusion, the mortality rate in ruptured uterus was 75%. To-day it is a different story—10.5%. Even so, it is very high. It emphasizes more and more the preventive aspect of the problem.

SECTION VII

AFFECTIONS OF THE NEW-BORN

CHAPTER XLVI

ASPHYXIA NEONATORUM

NORMALLY a well oxygenated baby cries and begins to breathe immediately or within a few seconds of its birth. Sometimes, due to various factors operating in the antenatal and intrapartum periods, the new-born does not breathe for some time. While the heart continues to beat, respiration is not established and to this condition the term asphyxia neonatorum is applied.

In recent years several investigations have been made on this subject. These investigations have established beyond doubt that deficient oxygen supply to the fœtus is the prime factor in the production of asphyxia. Asphyxia however produced, in infant or adult, is a state of inadequate oxygenation and inadequate elimination of carbon dioxide. Asphyxia produces respiratory acidosis which, if allowed to continue, results in a superimposed metabolic acidosis. The infant who is apnœic or who does not breathe effectively at birth has a lowered oxygen tension and an elevated carbon dioxide tension which produces a respiratory acidosis with falling pH. This situation is rapidly reversed when adequate ventilation is normally or mechanically established. But if the asphyxia continues, metabolic acidosis is established and is not readily reversed.

Various factors tend to produce asphyxia :—

(1) During pregnancy—diminished oxygen supply to the fœtus may be the result of maternal diseases like anæmia, heart disease,

pulmonary diseases, diabetes, hypertension and pre-eclamptic toxæmia. These give rise to anoxia by rendering the maternal blood anoxic or by diminishing the blood supply to the placenta.

(2) It may occur when the placenta is diseased as in syphilis or infarction.

(3) When placenta prævia or premature separation occurs.

(4) Hypoxia may be produced by obstruction to circulation as in cord compression and true knots of the cord.

(5) It may also result from congenital cardiovascular abnormalities in the fœtus.

(6) When the fœtus has hæmolytic disease.

(7) Placental insufficiency—post-maternity.

During labour fœtal anoxia is usually due to:

(1) Cord compression, placental separation or excessive retraction of the uterus and prolonged labour.

(2) Intracranial hæmorrhage—it may result from excessive moulding of the fœtal skull or injury sustained during normal or operative delivery. Such intracranial hæmorrhage prevents an adequate circulation of the blood to the brain by increasing intracranial tension. Thus local anoxia is produced.

(3) Medullary depression due to drugs. One of the common causes of asphyxia is the administration of analgesics and sedatives to the mother for the relief of pain—morphia, barbiturates, general anæsthetics and other commonly used sedatives can give rise to medullary depression and severe asphyxia in the new-born.

In asphyxia neonatorum we have to deal with a condition in which the medulla fails to initiate the vigorous impulses which are so characteristic of the normal infant. It fails not because of any lack of stimuli—afferent nervous stimuli—but because the sensitivity of the medulla to such stimuli is reduced by the anoxia. During birth the factors mentioned above give rise to anoxia and hence medullary depression and asphyxia.

The Diagnosis of Fœtal Distress. The advent of electronics in medicine has resulted in very accurate studies of intranatal physiology and we are gaining more and more new information regarding the physiology of the fœtus *in utero*.

In many clinics now the fœtal heart is monitored by electronic devices and fœtal electrocardiograph also is fast becoming an equipment of the labour rooms. Monitoring the fœtal heart-sounds through a central switch board so that the obstetrician can listen to it sitting in his office is already an achieved event in certain clinics. The stetho-

scope is still of considerable value in assessing the foetal heart rate. A persistent foetal heart rate of 100 or less in between contractions of the uterus is a sure sign of foetal distress. If it happens to be irregular also, the distress is no longer suspect but confirmed. Less important is a rapid foetal heart—but if it is more than 160 and continues to be so, it may be taken as indicating foetal distress. The slow foetal heart is, however, of greater importance.

Meconium staining of the liquor amnii in vertex presentations is an indication of low level of oxygenation and therefore is a sign of foetal distress. Opinion on this point is however varied. We believe that simple meconium staining of the liquor in a vertex presentation is only a sign for more careful watch on the foetal heart rate. By itself we do not take it as a sure sign demanding immediate delivery but we have no objection to complete the delivery if it can be done easily *per vaginam*. On the other hand, if, in addition to meconium staining, there are other signs like an irregular or slow foetal heart, we take it as a definite sign of foetal distress.

Attempts have been made by various workers using electronic equipment to ascertain the relationship, if any, between foetal heart rate patterns and the passage of meconium. Though definite conclusions have not been established, the impression is gained that the condition of the infant at birth could be predicted with greater accuracy from the foetal heart rate pattern than by the passage of meconium. The presence of meconium in a vertex presentation is therefore considered a warning of possible foetal distress, but does not by itself constitute a ground for interruption of labour.

In recent years hypoxia of the foetus is being reliably diagnosed by means of chemical analysis of the foetal blood. The determination of the pH value of the foetal blood provides sufficient information about the oxygen supply to the foetus. Saling who has pioneered in this field takes samples of the foetal blood from the presenting part of the foetus—usually the scalp—by special instruments and technique and determines the pH of the foetal blood. If there is acidosis in the central circulation this is reflected in the pH value of the peripheral blood taken from the presenting part. Value below 7.2 is said to be indicative of foetal distress. Co-relation has also been shown between foetal heart rate variations and the pH of the foetal blood.

The caput succedaneum. There is always in normal labour a small caput on the vertex. But in obstructed and prolonged labour the caput increases considerably in size and most of the babies with a large caput have been born asphyxiated at birth. A large caput is a sign of foetal distress and indicates early delivery.

There are various methods for assessment of the degree of asphyxia. It was customary to classify asphyxia into blue or asphyxia livida and white or asphyxia pallida. In blue asphyxia the baby is cyanosed and blue in colour, muscular tonus is not lost, cutaneous reflexes are present, muscles are fairly firm and sphincters are active. The cord is full and heart-beats are strong. The child may occasionally make an attempt to breathe. In asphyxia pallida the child is pale or grey in colour rather than white. All the muscles are flaccid, the tone is lost, cutaneous reflexes are absent, the sphincters have lost their tone, the heart rate is slow, sometimes irregular and feeble. The baby is in a state of shock.

This traditional classification is unfortunate because it diverts attention from the really important matter of the state of the peripheral circulation upon which the differences in colour depend. White asphyxia is in reality synonymous with 'fœtal shock'. If blue asphyxia is allowed to persist for more than three or four minutes, white asphyxia may quietly take its place. It is needless to state that fœtal shock is a grave condition and implies bad prognosis.

In the new-born infant, respiration of a gasping type indicates severe depression of the medulla. If over a period of five minutes the gasps become progressively less frequent and the intervals between them increase, the medullary damage is perhaps irreparable. If even with more frequent gasps the respiration does not change in character to normal within ten minutes the damage to the medulla is again perhaps irreparable. The above criteria will have to be modified if the depression of the medulla is due to drugs. In such cases, even after longer time, recovery is feasible.

The degree and duration of asphyxia can be estimated accurately only by determination of pH and buffer base values, a procedure which is totally unsuited for routine clinical practice. At the same time it is necessary to have some means of determining within reasonable limits the severity of neonatal distress from observations made in the delivery room. One of the acceptable systems which can be easily carried out is the scoring system devised by APGAR. It is based on observations made 60 seconds after complete birth, of heart rate, promptness and vigour of first respiratory efforts, response to a specific stimulus, muscle tone and colour. The scoring card is shown below. The stimulus used is a glancing slap on the soles of the feet.

Sign	0	1	2
Heart rate	Absent	Slow (Below 100)	Over 100
Respiratory effort	Absent	Slow (Irregular)	Good
Muscle tone	Flaccid	Some flexion of extremities	Active motion
Reflex irritability	No response	Cry	Vigorous cry
Colour	Blue-pale	Body—pink; Extremities—blue	Completely pink.

The highest possible score is 10. The majority of new-borns are vigorous with a score of 7-10. They cry within a few seconds of delivery and require no resuscitative measures other than cleaning the throat. Infants who are moderately asphyxiated have a score 4-6. They usually improve promptly after resuscitative measures by simple artificial oxygenation. The severely asphyxiated baby has a score of 4 or less. The scoring is usually done by the person conducting the delivery in whose hands the child is. The neonatal death rate drops sharply above a score of 4. Vigorous attention is required to those having a score of 4 or less.

There are certain important principles to be remembered in the management of asphyxia neonatorum. The initiation of respiratory impulses in the medulla depends upon its sensitivity and upon the chemical and nervous stimuli which reach it. In the adult the medulla is more responsive to chemical stimuli than the afferent nervous stimuli, whereas in the new-born the medulla is more sensitive to afferent nervous stimuli than chemical stimuli. Hence the changes in CO_2 tension result in little change in the new-born. It has to be emphasized that anoxia resulting from various factors is the precipitating cause of asphyxia. The viability of the medulla mainly depends upon its oxygenation and the initiation of the respiration is mainly dependent on the integrity of the medulla. So long as the medulla is alive, the issue turns upon the success or failure of the respiratory movements in securing aeration of the lungs. Expansion of the lung can be hindered mechanically either in the upper respiratory passages as far as the larynx or in the lower respiratory passages as low down as the alveoli. Obstruction in the upper respiratory tract is likely to be due to mucous, blood clot or meconium, and can easily be removed by gauze or mucous sucker. Another mechanical cause is the falling back of the epiglottis and for this the pulling forward of the tongue is a good remedy.

In the lower respiratory tract the important cause of obstruction is liquor amnii which can get freely into the bronchioles and lung alveoli during inspiratory efforts. This is the commonest and most important factor in those cases where the earliest respiratory movements fail to aerate the lungs. Although intra-uterine respiratory movements occur, they are normally feeble in their effort. The nervous system of the infant *in utero* is protected from external stimuli and is asleep. If intra-uterine anoxia sets in during pregnancy, it sometimes gives rise to a gasp and the fetus may swallow liquor amnii. Such anoxia is more likely to occur in labour. The greatest danger of aspiration of liquor amnii into the respiratory passages in vaginal delivery occurs towards the end of delivery and immediately after. The first few breaths it takes carry the liquor into the pulmonary alveoli and may prevent further aeration of lungs. In caesarean section—especially

classical—when the baby is attempted to be delivered by pulling on its feet, with its head still in the amniotic cavity, as a result of nervous stimuli acting on the exposed body it begins to breathe and may suck in liquor amnii which may be enough to fill the air passage thus drowning it with liquor amnii.

Prevention of Asphyxia Neonatorum. The prevention of asphyxia prior to delivery is based on the recognition and avoidance of the causes. The obstetrician should as far as possible leave the delivery to normal forces and interfere only when really necessary. The injudicious use of analgesics, (especially barbiturates and morphine), oxytocics, and inhalation anæsthetics causes grave harm, especially to premature babies. Prolonged second stage, trauma due to faulty forceps application and breech extraction are the common causes of asphyxia. Hence the prevention of asphyxia consists in careful technique in delivery with minimum trauma to the child, avoidance of inhalation anæsthesia and minimal use of analgesics. Especially where prolonged labours are to be terminated by operative delivery, inhalation anæsthesia is best avoided not only in the interest of the mother but in that of the child also. During labour the foetal heart must be listened to frequently—every 15 minutes—after rupture of the membranes. When asphyxia threatens as made out by auscultation, immediate steps should be taken to complete the delivery. In cases where it is not certain and delivery is likely to take a little time, administration of oxygen to the mother may help to prevent respiratory depression due to anoxia.

Treatment after Delivery. When a child is born and is not breathing it is important to determine if the asphyxia is mild or severe because, if severe, no time is to be wasted on inefficient methods, while in the mild cases the simplest remedies are usually successful. The heart beat, the reaction in the skin and throat and the degree of respiratory rate will help in arriving at a quick diagnosis:—

The principles governing the treatment are :—

- (1) Proper position of the child.
- (2) Maintaining body warmth.
- (3) Cleaning the respiratory passages.
- (4) Supplying oxygen to the lungs.

Position of the head of the child. In normal deliveries always keep the head of the child down so that it helps not only in draining the upper respiratory passages but also prevents aspiration of the liquor into the lungs immediately after delivery. If, however, a baby is

delivered after a difficult forceps operation or breech extraction and a possibility of cerebral hæmorrhage exists, it would be unwise to keep the baby with its head lower than its body as it might aggravate the hæmorrhage.

Maintaining body warmth. All babies should be kept warm covered by a blanket. It is more necessary in cases of premature infants. Severely asphyxiated babies are in a state of shock. All handling must be gentle and should be reduced to the minimum.

Cleaning the respiratory passages. During delivery as soon as the child's nose and mouth appear they are cleaned with pledgets of sterile gauze or linen. After delivery of the head the throat is cleaned gently by a piece of soft gauze on the finger. This is all that is required in the mildest cases. The irritation of the throat stimulates cough and respiration.

If the baby does not gasp or attempt to do so, the air passages must be cleared. For this purpose a mucus sucker is used. There are various types but the simplest one consists of a soft rubber or plastic catheter to one end of which is attached a glass trap connected to either a rubber tube for suction or a rubber bulb for the same purpose. The catheter is introduced into the oropharynx and all secretion sucked out. When the air passages are thus cleared the baby may begin to breathe at once. If not, oxygen should be administered. In severe asphyxia, administration of oxygen through the endotracheal tube is advocated. Great care should be taken in endotracheal aspiration of the mucus from the respiratory passages, and it often requires a skilled person to do it. It is of infinite value in the management of severe cases, though it need not be done as a routine in all.

Administration of Oxygen. The medulla is depressed because of anoxia. Hence oxygen must be supplied to it in time if it is to stimulate respiration. In the mild cases oxygen administration may not be necessary. When by clearing the throat of mucus, no attempt at breathing is evident, oxygen must be supplied either through a mask or through a nasal catheter. The secretion from the upper respiratory passages must be sucked out, and as the baby begins to gasp and breathe, the colour returns and respiration becomes more regular and established. Tickling the soles of the feet at this stage may help in quicker establishment of respiration.

If the response is unsatisfactory, oxygen should be administered through the endotracheal tube under pressure, after sucking out any secretions. The pressure should not exceed more than 30 ml. of water.

The concentration of oxygen in the mixture need not be more than 60%. If the child is improving, gasps recur with increasing frequency and the heart impulses become stronger and regular. Ultimately normal respiration is established and the child begins to cry, when oxygen can be discontinued.

Large amounts of fluid are seen in the stomach of babies born of diabetic mothers, and after *cæsarean* section. The aspiration of the stomach contents into the pulmonary alveoli is a frequent cause of neonatal death and hence aspiration of the stomach contents through a No. 8 F catheter passed into the stomach is recommended as a routine in babies born after *cæsarean* section and children of diabetic mothers.

Drugs. Cardiac and respiratory stimulants are of little value in the management of asphyxia as it is due to failure of the respiratory centre because of anoxia. Coramine, and other similar drugs which were employed very frequently are now seldom employed. Drugs are now used only when the asphyxia is the result of sedatives administered to the mother for relief of pain. When the asphyxia of the baby is due to the administration to the mother of morphia, pethidine, chlorpromazine, the injection of 2 mgm. of N-Allyl normorphine (Lethidrone) into the umbilical vein soon after birth gives surprisingly good results. Instead, if asphyxia is suspected, just prior to delivery, 10 mgs. of Lethidrone could be injected intravenously into the mother instead of into the child after delivery.

Artificial Respiration. We have made no mention of artificial respiration in the management of these cases—a method which was extensively used. Various methods have been employed. As these methods are dangerous when used on a badly asphyxiated and shocked baby, they are no longer employed. If at all, only gentle rocking methods are recommended. Electrical and mechanical machines for correct rocking are available. Eve's rocking method could be employed where no mechanical facilities exist. For this purpose, the obstetrician holds the baby in both his arms with elbows close to his side and his feet 18"-20" apart. He then bends from his waist to each side alternately with the baby, keeping his legs straight, about 18-20 times a minute. This form of artificial respiration is least harmful. If asphyxia is due to birth trauma, or intracranial hæmorrhage is suspected, artificial respiration should not be attempted.

In general, babies that survive usually recover within 10-15 minutes of birth. If not, there is very little hope of recovery.

A large volume of evidence is available attributing to asphyxia or to trauma in pregnancy and labour various cerebral and central

nervous system defects. The trauma sustained need not be of a major degree nor necessarily visible. Intra-uterine anoxia, anoxia in labour, intracranial damage and asphyxia neonatorum are now said to be important factors in the ætiology of these central nervous system defects in young children. Mental retardation, cerebral damage and other forms of palsies have been traced to both injuries or to anoxia at birth or *in utero*. Prevention of asphyxia therefore becomes of supreme importance in obstetrics.

Pulmonary Hyaline Membrane. This is also intimately connected with neonatal asphyxia. Pulmonary hyaline membranes are the leading cause of deaths of premature infants. At autopsy the lungs are purplish red, noncrepitant, firm, and a small to a moderate amount of fluid may be expressed from the cut surfaces. Some of the alveolar ducts and a few bronchioles and alveoli are expanded or even dilated and are lined by a layer of acidophilic granular or homogeneous material. This is the so-called 'hyaline membrane' which partially or completely encircles a number of air spaces and usually adheres closely to their walls.

The pathogenesis of pulmonary hyaline membrane is not established and various theories have been put forth. It was previously supposed that the membranes are formed from protein derived from the amniotic fluid. The view now held is that the proteins are derived from the blood of the fœtus or infant. As to the nature and origin of the eosinophilic hyaline matter, numerous investigators have attributed it, primarily, to injury of the pulmonary tissues. The hyaline formation has been ascribed to a variety of causes such as circulatory injuries of asphyxia, degenerative lesions of the air passages and toxic effects of prolonged exposure to abnormally high concentration of oxygen.

This membrane has been found in the distal air spaces of the lungs during autopsy of babies dying of neonatal asphyxia. The following facts should be remembered.

- (1) Pulmonary hyaline membrane is never found in still-born infants.
- (2) It is also not found in infants who die within one hour of birth.
- (3) Infants dying from 1 hour to 48 hours after birth show the greatest incidence. It is found only in 10% of infants dying after the fourth day of life.
- (4) The membrane is found twice more frequently in the premature.

(5) Only 5% of mothers whose babies showed hyaline membrane had normal pregnancies and deliveries.

(6) Fœtal distress, placenta prævia and cæsarean section give rise to greater incidence of hyaline membrane.

The hyaline material interferes with proper æration of the lungs and hence in the neonatal period, attacks of cyanosis and dyspnœa are seen. The increased incidence of hyaline membrane in the premature infant is attributed by some to oxygen-poisoning. These premature babies soon after birth are placed in incubators and oxygen is administered to them under pressure continuously for days, if they survive. Not all cases of hyaline membrane need be fatal. Prophylaxis consists in postural drainage and suction of the respiratory tract, especially after deliveries associated with anoxia and routinely after cæsarean section. In the treatment of neonatal asphyxia oxygen concentration need not exceed 60%.

Treatment of such infants is largely supportive. Properly humidified oxygen should be administered and oral feeds withheld. Antibiotic therapy because of frequency of pneumonia may have to be given in some cases.

ACCIDENTS AND INJURIES TO THE CHILD

THE fœtus is subjected to great strain during the process of delivery and not infrequently accidents and injuries result. Sometimes death of the fœtus *in utero* may occur either during pregnancy or during parturition.

Birth Injuries

During the course of delivery the fœtus may be subjected to many injuries, some of which may be insignificant, while others are so pronounced that they either cause a still-birth or favour neonatal death. Among these injuries may be mentioned :—

A. Injuries to the Head

Cephalhæmatoma. During the process of delivery a soft boggy swelling forms on the presenting part, which becomes more pro-



FIG. 134.—Cephalhæmatoma
A. Single. B. Double.

nounced in cases of prolonged labour. This is known as a *caput succedaneum* and is physiological. A type of injury that occurs in

some cases is known as a cephalhæmatoma. It may occur during delivery with forceps or in extraction of the breech, especially where there is some disproportion ; occasionally it develops after spontaneous delivery. The most usual situation for a cephalhæmatoma is over one or both parietal bones. Sometimes, however, it may form over the occipital bone or one of the frontal bones. It does not appear immediately after birth, in fact it is usually first observed some hours after delivery. It is very slow in disappearing and may take weeks to do so.

A cephalhæmatoma may be distinguished from a *caput succedaneum* by the following points :—

Cephalhæmatoma

May not appear at birth, but develops a few hours or even two or three days after delivery.

Is sharply limited by the sutures to a particular bone, the swelling being underneath the pericranium.

Swelling is soft and elastic ; does not pit on pressure.

Gradually increases in size for some time and takes weeks or even months to disappear.

Caput Succedaneum

Is always present at birth.

Is not well circumscribed and may be present over more than one cranial bone, the swelling being in the loose tissue of the scalp external to the pericranium.

Soft boggy swelling which pits on pressure.

Of maximum size at birth, gradually gets smaller and disappears usually in twenty-four hours.

In cases of cephalhæmatoma it is advisable to treat it on expectant lines. Although it may take a long time, sometimes months, before



FIG. 135.—Section of the fœtal skull showing the formation of *caput succedaneum*.

the swelling disappears, it is not desirable to incise it, as the chances of subsequent infection are great. In our experience expectant treatment has generally resulted in the gradual disappearance of the swelling, and the mother should be encouraged not to be over-anxious about the condition as by itself it causes no disability.

Bruises and lacerations are not infrequent over the vertex, especially in cases of forceps delivery.

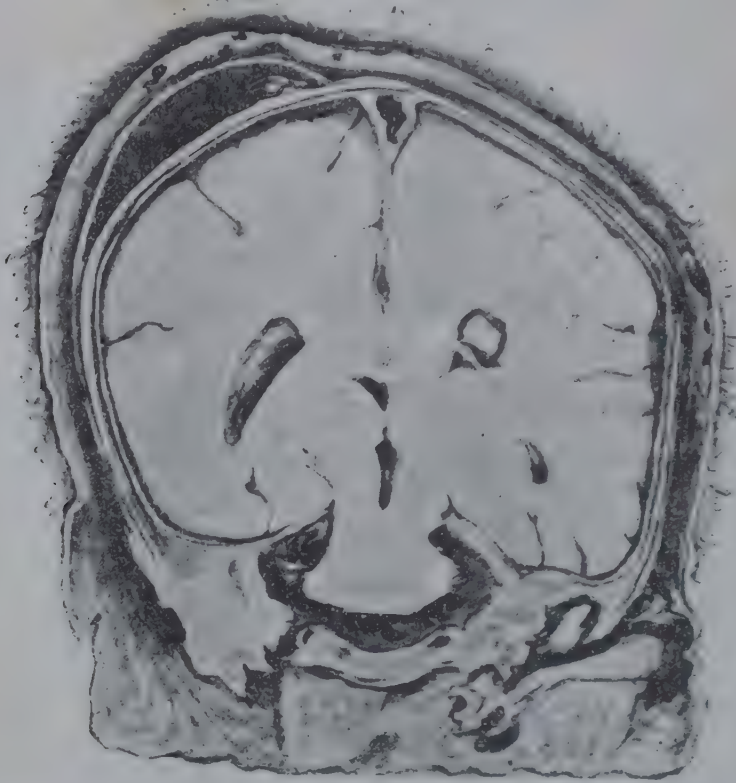


FIG. 136.—Section of the fœtal skull showing the formation of cephalhæmatoma.

Spoon-shaped deformity of the skull occurs where some resistance has been offered to the delivery of the head by a protruding sacral pro-

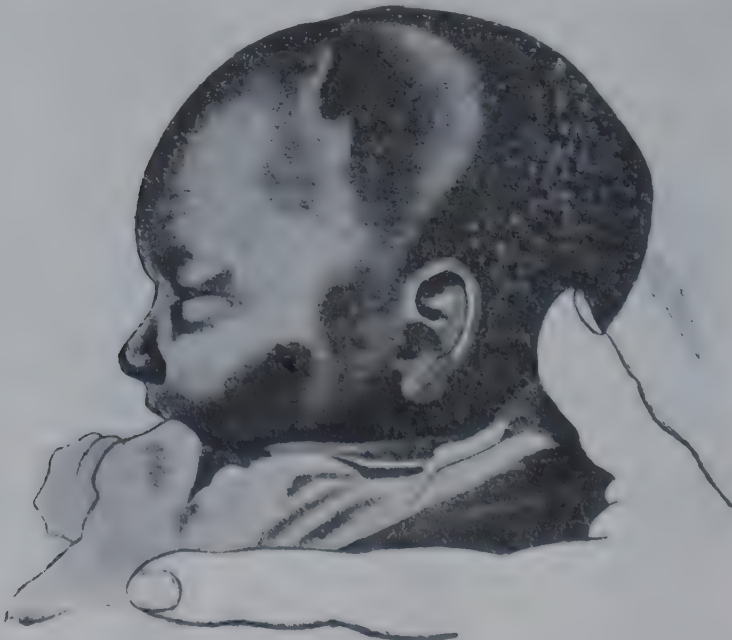


FIG. 137.—Spoon-shaped deformity of the skull.

montory and in some cases by pressure of the tip of the blades of the forceps. These spoon-shaped or gutter-shaped depressions are generally over one or other of the parietal bones or occasionally over the

frontal bone. The bone in the depressed area is usually fractured but in some cases there may be simple indentation. They generally correct themselves in course of time and do not call for any treatment unless there are signs of cerebral compression, under which circumstances surgical measures are indicated to elevate the portion of depressed bone.

Injuries to the eyeball. These may be due to faulty application of the forceps, sometimes resulting even in evulsion of the eyeball or to careless vaginal examination in face presentation.

Fracture of the lower jaw may occur during an unskilful attempt to deliver the after-coming head.

Hæmatoma of the sternocleidomastoid muscle occasionally occurs in the process of delivery of the shoulders. The hæmatoma is usually in the lower part of the sternomastoid muscle. A few fibres of the muscle may be ruptured by violent traction if combined with extreme torsion of the head. A blade of the forceps may deeply crush the muscle and lead to a myositis. The child cries incessantly, especially when handled, and torticollis may result.

Intracranial hæmorrhage. This may result from fracture of the skull, from undue and especially sudden compression of the head, from spoon-shaped and grooved depressions of the bone or from excessive pressure exerted on the cephalic pole as a whole. Tears of the tentorium cerebelli and of the falx cerebri are not uncommon. The rupture of a cerebral or meningeal vessel may sometimes be caused by excessive overlapping of the cranial bones during head moulding. This is not infrequently the case in the delivery of the after-coming head, in forceps delivery of occipito-posterior positions and wherever excessive force is used during traction in forceps deliveries. When intracranial hæmorrhage occurs, the child may be born deeply asphyxiated, or the symptoms may come on within three or four days after birth. Usually, the child is restless, cries incessantly, is not able to take nourishment and later, twitchings of the muscles, convulsions, fever, cyanosis with rapid and irregular respirations due to atelectasis may manifest themselves. In severe cases, the child dies during the neonatal period. If it does recover, the possibilities of complications developing later, such as epilepsy, spastic paraplegia or a form of congenital idiocy, should be borne in mind.

B. Injuries to Nerves

Injury to the Facial Nerve. This is about the most frequent form of birth injury to nerves. It is due to the pressure of the forceps during delivery. In the majority of cases, the facial paralysis that

results is of a temporary nature, and within two or three days at the most, the facial deformity disappears. If, however, the facial paralysis is due to intracranial injury in which the facial nerve has become involved, the paralysis may be permanent.

Brachial Palsy. This results from excessive traction in the delivery of the shoulders. Occasionally, it may be due to compression by a blade of the forceps. The paralysis that results is known as Erb's palsy. It is due to injury to the fifth and sixth cervical roots. As a result of this paralysis the arm assumes a characteristic position. It



FIG. 138.—Facial Palsy.

cannot be flexed at the elbow, raised or abducted. The movements of the wrist and the fingers are not impaired. Abduction of the arm is weak and rotation is feeble or absent. The sensation remains undisturbed, but muscular atrophy rapidly sets in. In the majority of cases, however, the prognosis is favourable, as with the recovery of the nerve roots from the effects of bruising and compression by the exudate, the paralysis gradually disappears. Proper treatment is essentially prophylactic. Care must be taken during delivery of the shoulders to avoid too powerful traction on the head or excessive torsion of the neck. If paralysis has resulted, the arm should be carefully bandaged to the side and kept at rest for a few days, after which, physiotherapy should be started.

Musculospiral Nerve Paralysis. This occurs owing to the long course of the nerve, its position in relation to the humerus, and its

special liability to compression. Injury to the nerve is followed by dropping of the wrist and fingers. It is a mixed nerve, containing sensory, motor and vasomotor fibres, but the symptoms of the injury are almost entirely motor. The nerve is usually injured in the middle-third of the arm from a fracture of the humerus.

Treatment consists in keeping the arm at rest with the hand dorsi-flexed and physiotherapy.

C. Fracture of Bones

Fractures of the Clavicle, Humerus, Femur and the Lower jaw may occasionally result especially from a difficult breech extraction. In all such cases it is best to have the child treated by an orthopædic surgeon.

Surgical Affections of the New-Born

Imperforate anus, depressed fractures of the skull, fractures of the long bones tracheo-oesophageal fistulæ, diaphragmatic hernia are some of the surgical conditions requiring urgent attention. It is not proposed to discuss any of these conditions as they now belong to the realm of pædiatric surgery. Various deformities requiring surgical correction may be met with at birth. It is always best wherever circumstances permit to refer the baby for specialist treatment.

PREMATURITY AND LOW BIRTH WEIGHT

ALL infants born before thirty-seven weeks of pregnancy, may be considered as premature. The diagnosis of prematurity depends not only on the period of gestation when the child is born but its weight at birth.

The international standard laid down for prematurity is a birth weight of less than 2500 G. In most European and American countries the birth weight is of the order of 3300 G. In Asian countries—India, Burma, Ceylon, Thailand and Philippines—the average height and weight of the adult and the average weight of the new-born are less than in European and American countries. In South India the average term birth weight among the low socio-economic class is only 2736 G. as compared to 2948 G. in the upper classes. If the international standard of prematurity is applied then in India based on hospital data (mainly the low socio-economic group) the incidence of prematurity ranges in the different regions of the country from 25% to 36%. If 2045 G. or less which is acceptable as standard for prematurity in India is accepted, then incidence of prematurity in the same group will be 12% to 25%.

It is now increasingly realised that the term 'prematurity' is misleading. The WHO Expert Committee of Maternal and Child Health (1961) has suggested the term 'low birth weight' for the level of birth weight that is taken to be low, which may vary in different communities. Many different factors affect birth weight and hence the incidence of low birth weight however defined. Birth weight tends to be higher and the incidence of low birth weight lower in multiparæ than in primigravidæ. In 65% of low birth weight babies maternal complications like pre-eclamptic toxæmia, hypertension, anæmia antepartum hæmorrhage, cardiac disease, multiple pregnancy, Rh. incompatibility, diabetes and other maternal diseases could be found while in the remainder no ætiological factors may be evident. Babies of low birth weight have higher mortality and hence require special care.

Characteristics of infants of low birth weight. Infants born at 37 weeks or earlier weigh usually less than 2500 G. are 18 inches (45.7 cm.) or less in length and are small and frail with relatively big hands and head. The ears are soft and poorly formed. The skin is

fine, often lanugo-covered, delicate and easily infected. The abdomen is protuberant and thin-walled. The cry is feeble. Sucking and swallowing are weak and may be absent in very immature infants. Mucus gathers in the mouth and regurgitation which easily occurs even before food is given involves the danger of aspiration pneumonia. Expansion of the lung is poor, breathing may be irregular and cyanosis often occurs with handling and feeding. The cough reflex is poor and temperature unstable. Infections are readily acquired. Jaundice is more common and more intense. The stomach capacity is small and feed is poorly absorbed. The skull is thin. In the presence of anoxia because of fragility of the capillaries the danger of cerebral hæmorrhage is increased. Malformations are more common than in full term babies and may affect any organ but chiefly the nervous gastro-intestinal and cardiac systems. The immature infant has many hazards to overcome. The greatest of these is the poor pulmonary ventilation. Survival largely depends on the degree of maturity of the lungs at birth.

Management of the infant immediately after delivery.

Immediately after cutting the cord and gentle aspiration of the pharynx, the premature baby, handled with extreme gentleness, should be covered with a warm blanket and kept warm in a cot. The head should be slightly lower than the body and turned to one side; the tongue should not be allowed to slip backwards. The mouth and nasopharynx should be gently sucked out with a soft rubber catheter. The cord is double-ligated with sterile ligature about $2\frac{1}{2}$ in. (6 cm.) from the abdominal wall, leaving a long enough stump to permit exchange transfusion to be carried out if this should be required. A sterile dressing is applied. A single intramuscular injection of 1 mg. of vitamin K analogue should be given if the mother has not herself been given vitamin K during labour.

Management of the Neonatal period. Under tropical conditions it is necessary to develop a simple planned routine which is capable of adjustment where necessary, and which can be carried out by staff limited in numbers and in training, assisted, in most cases, by the infants' mothers. The most important asset in a premature unit is trained, skilled and dedicated, nursing staff.

In most premature infant centres in the country, mothers have to help to care for their infants due to lack of staff. As each mother deals solely with her own baby, the likelihood of cross-infection is lessened. Accommodation for the mother should therefore be available near the premature unit, so that she can provide expressed breast-milk for the infant during his early days, which will also maintain lactation until the baby can suckle.

A new-born premature needs rest. The baby should never be handled unnecessarily and the handling should be minimal. Everything possible should be done in the cot, and always before and not after feeds, to lessen the risk of regurgitation. Weighing need only be done twice weekly.

Clothing should be simple, easily changeable, loosely fitting, and light in weight, made of washable material which conserves heat well, such as flannelette. The baby's head can be covered by a hood or bonnet. Heat conservation is essential.

No bathing is needed, either at birth or, until the baby is progressing satisfactorily. The vernix protects the tender skin and should be allowed gradually to peel off spontaneously. Some authorities advise the gentle, daily application of a sterile vegetable oil—olive oil to the skin folds and to the buttocks, after the child has been cleaned.

The temperature of the baby should be taken once daily. A stable temperature between 96° and 99°F (35.6° to 37.2°C) is desirable. Premature babies are extremely thermolabile. It is therefore important to give them an environment of fairly constant temperature and humidity. This can be done in a variety of ways. The plan adopted will depend on the climatic conditions of the particular place, which must be known for all seasons of the year, especially if they vary greatly. Temperature and humidity can best be controlled by means of an incubator. However, it is doubtful if these are necessary in the tropics. Alternatively, the ward for the prematures may be warmed to 85°F (30°C) and humidified (65 per cent moisture). This can be done by a thermostatically controlled air-conditioning plant or by means of various humidifying and heating devices in the ward itself, such as electric heater, or hot-water radiator. The simplest arrangement is to keep one or more steam kettles (depending upon the size of the room) boiling constantly, unless the climate is very humid.

Prevention of Infection. Infection can occur easily and insidiously in all new-born babies, and particularly in the premature who have low antibody levels and leucocytes with poor phagocytic ability. Infection may enter via the intestinal tract, the respiratory system, the skin or, as a special neonatal hazard, the umbilical cord stump.

As a general principle to be applied whether premature babies are being cared for at a hospital or in the home, no one should come into contact with these vulnerable infants unless their presence is really essential.

All staff should be made aware of the danger to premature babies of common place infections in the attendants even if they are minor

such as 'colds', boils etc. These infections may be mild and unimportant to adults, but lethal when transmitted to neonates.

It is desirable that personnel attending on prematures should wear sterile masks, caps and gowns. They must be boiled or, preferably autoclaved after use.

All prematures showing evidence suggestive of infection should be isolated and treated, although this is often difficult to judge because of the lack of diagnostic signs.

Oxygen. This should be available in every premature nursery, either in individual cylinders or piped from a central oxygen bank. It can be given through a mask or nasal catheter. It should only be used briefly, as long as cyanosis is present without it, and never in concentrations of more than 40 per cent.

Feeding. The preparations, storage, and administration of feeds without contamination is vital. When expressed breast-milk is used, mothers must be instructed and supervised in clean methods of manually squeezing the milk from their breasts into a sterile vessel.

Syringes, pipettes, bottles and other feeding apparatus must be sterilized by autoclaving or boiling. Numerous regimes are advocated by different authorities.

Small premature babies do not usually need to be fed for the first 48 hours of life, although, in some centres, there has recently been a trend towards earlier feeding. Larger, active babies may start feeding after 24 hours. Small premature babies may be given up to ten 2-hourly feeds, progressing to 3-hourly intervals later.

They should be fed in the cot. During and after feeds, the head of the cot should be raised a little and the infant slightly turned on to its right side. These manœuvres tend to prevent regurgitation.

The first feed should consist of 4 ml. of a sterile clear fluid such as normal saline, 5 per cent glucose solution or boiled water. It may be given with a pipette, a medicine dropper or a spoon. It tests the infants swallowing reflex with little danger of aspiration, and will reveal a congenital lesion such as tracheo-œsophageal fistula. Subsequent feeds should be of undiluted human milk, at first expressed and later direct from the breast. This is the best food that can be recommended for the premature baby in the tropics. If (and only if) breast-feeding is impossible, such as when the mother dies in childbirth and there are no lactating relatives or as a means of complementing breast-milk feeds artificial feeding is resorted to. High protein, high carbo-

hydrate, low fat artificial feeds are most suitable. Any reliable half-cream powdered milk with added sugar can be used.

The principal difficulty in the feeding of premature infants is the paradox of high nutritional needs, about $3\frac{1}{2}$ oz. of milk per lb. (250 ml. per kg.) body-weight per 24 hours, and small stomach capacity, associated with a weak cardiac sphincter and a poor cough reflex, so that regurgitation and aspiration are likely. The danger of over-filling the stomach is much greater than that of under-feeding.

Complications of immaturity. The immature infant is prone to many complications the important ones being respiratory distress syndrome (pulmonary hyaline membrane) and retrolental fibroplasia. Aspiration pneumonia, cyanotic attacks, gastro-intestinal infections and cerebral hæmorrhage are also common.

Pulmonary hyaline membrane. More than half of the neonatal deaths in premature infants occur within the first 24 hours. Over 90% of deaths occur in the first week of life. The condition responsible for most deaths of premature infants is a syndrome characterised clinically by respiratory distress and pathologically by a hyaline like membrane in the alveoli of the lungs.

In the lungs of premature infants dying from this syndrome is found an eosinophilic homogenous membrane with a hyaline-like appearance lining the alveoli and air ducts. There is also in association atelectasis. Many authorities regard the membrane as aspirated vernix material while others believe that it is the result of extravasation of plasma into the alveoli after the inter-alveolar capillaries get damaged as a result of hypoxia.

Clinically these infants are in good condition at birth but in a few hours develop dyspnœa, retraction, cyanosis, episodes of apnœa and finally death. The incidence of the distress is more common when pregnancy is complicated with antepartum hæmorrhage, toxæmia and diabetes and in babies delivered by cæsarean section. The treatment consists mainly in administration of oxygen of low concentration (30-50%). Humidity is important in the management of these cases and antibiotics should be administered as prophylaxis against pneumonia. It is best to place such babies under the care of a pædiatrician.

Retrolental fibroplasia. This is another condition found in premature infants and consists of the formation of an opaque tissue behind the lens of the eye during the first few months after birth. It is now well established that this disease is caused by the exposure of premature infants to high concentrations of oxygen (more than 50%) over periods longer than a day or two. Therefore the disease is wholly

preventable and prevention consists in administering oxygen to premature infants in concentration not exceeding 40% and avoiding its continuous administration for over three days unless absolutely essential.

The prognosis is grave—most of the affected infants becoming partially or totally blind.

Ideally low birth weight infants are best cared for by a trained team of pædiatricians and nurses in special premature baby units in hospitals.

HÆMOLYTIC DISEASE IN THE NEW BORN

HÆMOLYTIC disease is caused by incompatibility of blood groups between mother and foetus. Erythroblastosis foetal is a term used synonymously.

Ætiology. In 1940 Landsteiner and Weiner reported the finding of a hitherto unknown antigen in red cells. This antigen was called Rh as it was present in the red cells of Rhesus monkeys. It is present in about 85% of white races and in the remaining 15% it is absent. The former are termed Rh-positive individuals and the latter Rh-negative.

The Rh factor is not an entity and there are several varieties of the Rh antigen and therefore of Rh antibody. The Rh blood group consists of two sets of antigens. From each parent one set is inherited so that the group should strictly be denoted by a double symbol Rh/Rh. Each set in turn consists of three of the following separate antigens—(1) C or c, (2) D or d, (3) E or e and these must be substituted for Rh/Rh. Thus the Rh blood group of an individual might be CDe/cde. It is not proposed to go into varying nomenclatures and different combinations of the antigens that are likely to occur except to state that the commonest genotypes are CDe/cde and CDe/CDe. The incidence of Rh-negative women in South India is between 5% and 7%.

To determine the genotype of an individual the blood should be tested against all six antisera. However because of lack of proper antisera it is not always possible to determine the exact genotype in some cases. Of the several Rh antigens D is by far the most potent and anti D accounts for at least 95% of all the dangers due to Rh blood groups. In the discussion that follows Rh-positive should be taken to mean D positive and Rh-negative its absence.

An Rh-positive individual may carry D on both sets of antigens (DD) when he is termed homozygous or only on one set (Dd) when he is termed heterozygous. Majority of the Rh-positive individuals are heterozygous. This differentiation is of clinical importance in forecasting the possible Rh blood group of foetuses of Rh-negative woman married to Rh-positive man. If the husband is homozygous (DD) all children will be Rh-positive (Dd) and may stimulate antibody production in the mother and may therefore be affected by hæmolytic disease.

If the husband is heterozygous (Dd) then half of the children will be Rh-positive (Dd) and may be affected while the other half will be Rh-negative (dd) and will not be affected by hæmolytic disease. Thus it will help in assessing the prognosis.

The anti D antibody exists in two forms—saline agglutinins (immunoglobulin M) and albumin agglutinins (immunoglobulin G). The first will agglutinate red cells containing D when suspended in saline while the second will agglutinate only when in albumin. The albumin agglutinin is also called incomplete or blocking antibody and its presence in the maternal blood is of more serious import to the fœtus than the saline one.

ABO blood group also may affect the formation of anti Rh agglutinins. It has been observed that the bloods of parents of children affected by hæmolytic disease of the new born were disproportionately compatible on the ABO system. It has been suggested that if Rh sensitisation is due to fœtal red cells entering the maternal circulation then these cells might be eliminated before they had time to act as Rh antigens if there is ABO incompatibility.

There are two common causes of Rh isoimmunization—(1) Blood transfusion (2) Pregnancy.

(1) The transfusion of even a small amount of Rh-positive blood into an Rh-negative man or woman is likely to lead to Rh antibody formation especially if the Rh incompatible transfusion is repeated. If such a woman becomes pregnant and carries an Rh-positive fœtus, the fœtus is most likely to get affected by hæmolytic disease, as blood transfusion is a strong stimulant to Rh antibody formation. In fact if in a first pregnancy an affected baby is born it is almost always the result of a previous transfusion. Conversely if a woman has already been sensitised by a previous pregnancy, she may suffer from a severe hæmolytic reaction if transfused with Rh-positive blood. Hence the necessity to transfuse Rh-negative blood if the Rh group cannot be determined.

(2) Pregnancy with an Rh-positive fœtus—

The antibody formation during pregnancy depends on there being a break in the placental barrier which allows leakage of fœtal blood into the maternal circulation. With an Rh-positive fœtus and Rh-negative mother sensitisation can occur and the antibodies may pass the placental barrier to enter the fœtal circulation and produce hæmolytic disease in the fœtus.

Usually at least two pregnancies with Rh-positive babies are necessary before an Rh-negative mother produces Rh antibodies. The

efficiency of the placental barrier in either direction may vary in each pregnancy and is another factor to be taken into consideration. However at term the placenta is freely permeable to Rh immunoglobulin G.

There is no doubt that foetal red blood cells enter the maternal circulation as a result of pregnancy. Foeto-maternal hæmorrhage is usually detected by identifying and counting foetal red cells in maternal circulation. By special techniques, cells containing HbF can be identified from cells containing HbA. If the total number of cells containing HbF is related to cells containing HbA a numerical ratio is obtained and a quantitative estimation of the amount of foeto-maternal hæmorrhage may be calculated. In 50 low power fields approximately 200,000 red cells can be counted and a score of 5 foetal red cells represent a hæmorrhage of 0.25 ml.

Number of obstetrical complications may be associated with foeto-maternal hæmorrhage. The number of foetal cells in maternal circulation is increased in patients with pre-eclampsia and also after forceps delivery, cæsarean section and manual removal of the placenta as compared with normal delivery.

Pathology. The most constant gross finding at autopsy is enlargement of the spleen. According to Potter, a spleen weighing 25 gm. or more is pathognomonic only of foetal erythroblastosis or syphilis. Enlargement of the liver, though frequent, is less conspicuous than that of the spleen. The characteristic microscopic finding is widespread extramedullary hæmatopoiesis in the liver and spleen. A significant finding is hepatic and splenic hæmosiderosis the result of hæmolytic anæmia. The liver shows bile thrombi in the biliary capillaries and frequently focal or even extensive necrosis of the parenchyma. The brain may show icteric discoloration of the basal ganglion and other nuclear accumulation.

Examination of blood, if done early, will usually reveal an increase of immature nucleated erythrocytes (erythroblasts and normoblasts). Although this find gave the disease its name, erythroblastemia is not always present, especially if the examination is not done immediately after birth. It is also necessary to remember that counts up to about 5000 nucleated erythrocytes per c. mm. are physiological. The cord blood is a convenient source for early examination. Generally there is a hyperchromic (colour index above 1) macrocytic anæmia of varying severity and an increase in reticulocytes.

The placentæ of erythroblastetic foetuses show marked changes. Frequently the placentæ are enlarged especially with foetal hydrops. The normal ratio of the weight of the foetus to placenta of about 6 : 1 is sometimes reduced to as little as 3 : 1 or less. The placentæ on the

maternal surface are gray and friable. Microscopically the villi are larger and less cellular. Langhan's and Syncytial layers persist and stromal cells are increased. The blood vessels mainly along the periphery of the villi are fewer, their lumen frequently being filled with nucleated erythrocytes. The placentæ of fœtuses with icterus gravis type of erythroblastosis are less distinctive than in the hydrops group. The resemblance to a syphilitic placenta is striking.

Clinical Features. (1) The characteristic clinical features are œdema, jaundice and anæmia. The œdema may be generalised—hydrops fœtalis and affects the fœtus and the placenta. These babies are often born dead and if born alive die shortly. Pleural, peritoneal and pericardial effusions, generalised œdema and considerable enlargement of the liver and spleen are the characteristic post-mortem findings. By antepartum radiography it is possible to diagnose this condition. The radiograph may show a halo effect around the head due to œdema of the scalp and the fœtus is said to be in Buddha position with the legs and arms held away from the body by the large abdomen.

(2) Jaundice—Icterus gravis—This may be present at birth or may develop within a few hours—It is usually of the non-obstructive type but obstructive jaundice may supervene. The liver and spleen are always considerably enlarged. As the jaundice deepens the baby becomes irritable and drowsy. Signs of cerebral irritation soon follow and in severe cases there is neck retraction, generalised rigidity and opisthotonus. These are the cases with Kernicterus—bile staining of the basal ganglia. It arises because a high bilirubin level depresses tissue oxidation thus causing destruction of brain tissue. If the baby survives the acute stage, it may later develop severe physical and mental handicaps.

(3) Anæmia—This may be present at birth or may develop two or three weeks after birth. In some it may cause acute cardiac failure.

Diagnosis and Management. Efficient antenatal care of the mother includes the testing of her Rh group and when she is Rh-negative, tests for antibodies. Two types of antibodies are looked for—saline agglutinins and albumin agglutinins. Albumin agglutinins are of more significance as they indicate an advanced state of antibody production.

One of the major diagnostic problems is the assessment of the severity of the hæmolytic disease especially in relation to the early detection of hydrops fœtalis and early induction of labour. No clear cut rules can be laid down.

To ascertain the prognosis in a pregnancy certain methods have been recommended.

Estimation of maternal antibody titre—An indirect anti-globulin titre method is employed for the purpose. After 26 weeks weekly or fortnightly estimations are done. A titre of over 1/256 is taken as a standard for inducing labour after 34 weeks. It has been observed that all the foetal loss occurred when the antiglobulin titre was over 1/512. However the predictive value of titres is uncertain.

Liquor Amni Studies. Estimation of the concentration of bilirubin and oxyhæmoglobin in liquor amni has been employed as a method of assessing the severity of the disease and determining the time for induction. If the liquor bilirubin is less than 0.1 mg. per 100 ml. there is little risk but over 0.2 mgm. treatment will be required for the baby and over 0.4 mgm. there is a very great risk for the foetus. Thus repeated amniotomy at weekly or fortnightly intervals and estimations of the bilirubin content may help in predicting the severity of the disease and deciding the time for premature induction.

The critical amount of bilirubin in the liquor amni is small—0.4 mg. per 100 ml. and it has been difficult to detect this. The most popular method of predicting or assessing severity involves the determination by spectrophotometer of the optical density difference of the amniotic fluid at a given wave length usually 450μ (the wave length of maximum absorption of light in the presence of bilirubin). On the basis of results obtained by single or repeated amniocentesis, it is hoped that the foetus which is in danger of dying can be identified and measures taken to prevent it.

Timing and Method of Delivery. Immunised patients should be delivered at about the expected date. If early induction is required because of the possibility of intra-uterine death or the foetus being severely affected as predicted by amniotic fluid examination, artificial rupture of membranes and an oxytocin drip are the methods of choice provided there are no obstetrical contra-indications to vaginal delivery. This is applicable from about 35-36 weeks gestation. If delivery is indicated before this period induction might prove difficult with an increased risk to the foetus. In such circumstances elective caesarean section should be considered. When delivery is considered imperative before 32 or 33 weeks there is a *prima facie* indication for intra-uterine blood transfusion.

All deliveries of Rh-negative problem mothers should be in institutions with facilities for exchange transfusion. Immediately after birth a direct Coomb's test and Protein test should be carried out on the cord blood. At the same time the Hb and bilirubin estimation in the cord blood should be done. The tests are done as follows:—

The Coomb's Test. By this test sensitisation of red cells may be detected by the use of anti-human globulin serum. One drop of

thrice washed cord blood red cells suspended in saline is mixed on a tile with a drop of anti-human globulin rabbit serum, left for a minute then gently rocked and inspected for agglutination. Most sensitised cells will show strong agglutination in one to five minutes.

Protein Test. One drop of untreated cord blood cell sediment is mixed gently with one drop of 20 per cent egg albumin on a white tile or slide. The test is positive when agglutination is observed.

Coomb's test should always be done on all cases as this is a very sensitive test for detection of Rh sensitisation. If this test is negative the infant is not affected with hæmolytic disease due to anti Rh. Soon after birth it must be decided whether to leave the baby untreated and transfuse it later if it becomes necessary or to carry out an immediate exchange transfusion within a few hours of birth.

Exchange transfusion is usually given to :

- (1) All affected bodies with Hb level below 14.8 gm. %.
- (2) All affected babies who become jaundiced or in whom bilirubin concentration rises above 10 mgm. in the first 24 hours irrespective of hæmoglobin level.
- (3) Babies with cord bilirubin concentration of 4 mgm. per 100 ml. irrespective of Hb level.
- (4) Additional exchange transfusions are indicated when indirect bilirubin level is 20 mg. per 100 ml. or more.

Exchange transfusion is a very specialised procedure. At the time of delivery the obstetrician will do well to leave several inches of the cord to be used for replacement transfusion, in case of need and to ligature the cord as soon after delivery as possible to prevent further entry of anti-agglutinins into the child. It is not proposed to go into the technique of exchange transfusion except to state that to begin with about 30 ml. of blood is withdrawn from the baby to reduce the venous pressure. The replacement is then performed alternately withdrawing and injecting about 10 ml. of blood at a time until an exchange of 80 ml. per pound of body weight is reached. The rate of injection should be about 10 ml. per minute. The dangers of the procedure are cardiac failure, air and clot embolism and sepsis.

Selective induction of labour was for many years considered to be the only reliable method of reducing the still birth rate in Rh-hæmolytic disease. Recently successful attempts at pre-natal treatment of the infant has been reported. Liley (1963) described a method of transfusing the fœtus *in utero* by the injection of concentrated Rh (—) blood into the fœtal peritoneal cavity. The transfusion is made with a catheter introduced into the fœtal peritoneal cavity through a needle

inserted through the maternal abdominal wall, the uterine wall and the amniotic sac. An increasing number of successful intra-uterine transfusion by this method is being reported.

When erythroblastosis is suspected, analgesia and general anæsthesia should not be used during delivery because intra-uterine or neonatal asphyxia is present in many infants. Local or saddle block anæsthesia should be used.

Finally it is to be remembered that hæmolytic disease in the new born can occur as a result of ABO group incompatibility.

The fact that a pregnant woman is Rh-negative is, by itself, no cause for alarm. This fact becomes significant only if the husband is Rh-positive. Even then, the chances of erythroblastosis are minimal in the first pregnancy, unless there is a history of a transfusion with Rh-positive blood. The prognosis becomes more gloomy if there is a history of previous erythroblastotic babies. Also abortions make the outlook less encouraging because each abortion adds to the sum total of sensitisation. On the other hand, the Rh factor seems to be only rarely responsible for abortions.

A homozygous person with regard to the Rh factor is one who inherited the same Rh factor from both parents. All the children of such a person will be Rh-positive, more likely to sensitise their mothers and consequently more likely to have erythroblastosis. A heterozygous person is one who inherited a different Rh factor from each parent. If one of these inherited factors is the Rh-negative factor, then some of the children may be Rh-negative and consequently escape the disease. The importance of detecting if a prospective father is homozygous or heterozygous is apparent. This cannot be done in every instance because suitable diagnostic seras are either scarce or not available. In the case of persons of type, Rh₁ (CDe) an approximate determination can be made with so-called anti-hr₂ serum. Another method is to test the parents and living children. If any of them is Rh-negative heterozygosity is established. The chance of a patient 'at risk' actually developing antibodies is approximately 10 per cent after each pregnancy provided she is still at risk each time. The possibility of a patient with antibodies loosing her baby is between 6 and 10 per cent if modern facilities are available.

Prevention. Determining the Rh factor in pregnancy should be routine. If there is a history of foetal erythroblastosis or jaundice in a previous infant and Rh incompatibility has been excluded the possible role of other blood factors should be borne in mind. Using Rh-negative blood for transfusion to all Rh-negative female recipients,

regardless of age, will usually prevent erythroblastosis in primigravida and postpone its occurrence in multigravida.

Clarke and his co-workers by injecting Rh-positive red cells into Rh-negative male volunteers have shown that Rh antibody formation in their plasma could be prevented by injecting them with a potent anti Rh (anti D. albumin) plasma provided the incomplete antibody was used. Primiparous women at risk who were found to have fœtal red blood cells present in their own blood after delivery were given 5 ml. of gamma globulin containing incomplete anti-D of suitable activity. In a series of cases so studied it was observed that while in a control group 13% had become sensitised within six months after labour in the treated group none had developed antibodies. Further results have shown that the protective effect will persist through a further pregnancy when the fœtus is Rh-positive and ABO compatible.

There is thus clear evidence that women at risk can be protected against Rh isoimmunisation and thus children against rhesus hæmolytic disease. The risk to the mother is trivial but the problem of availability of anti D gamma globulin remains.

The immunoglobulin should be given within 72 hours of delivery. If the baby is Rh-negative there is no need for the injection.

OTHER DISEASES OF THE NEW BORN

Ophthalmia Neonatorum. This disease is most commonly due to infection of the eyes with gonococci during the passage of the head of the fœtus through the vagina. Other organisms, namely streptococci, staphylococci, bacilli coli and bacillus diphtheria are occasionally the causative agents of ophthalmia.

Clinical Features. About twenty-four to forty-eight hours after birth there is swelling of the eyelids and a yellowish watery discharge from the eye, the conjunctiva become inflamed and later a purulent exudate may be observed, the lids stick together and sometimes a considerable amount of pus may collect underneath them. The infection usually starts in one eye if care is not taken to prevent its spread, both eyes may be involved and may lead to severe ulceration and permanent loss of vision.

Prognosis. If treatment is taken in hand early, the prognosis is good, but in neglected cases the prognosis is very grave as permanent blindness may result.

Treatment. The treatment consists in instilling into each eye 1 ml. of 1 in 10,000 solution of penicillin every five minutes for one hour, then every half an hour for 4 hours and thereafter every hour till the end of 24 hours. Penicillin, 300,000 to 600,000 units parenterally, is also given. A simple and equally effective method is to wash off the discharge with normal saline and put in 5% Argylol drops. To prevent sticking of the eyelids, plasma ointment may be used. 1 ml. of P.A.M. in oil (300,000 units) is given daily for 3 to 4 days. Complete cure is obtained by these methods.

Icterus Neonatorum. A slight amount of jaundice is not infrequently seen in new-born. It appears usually on the third or fourth day after delivery and generally within the first week. It is seen first on the trunk and face, then on the extremities and conjunctivæ. In mild cases the urine and faces remain normal and the child's health does not suffer in any way. The jaundice usually disappears within four or five days, or at the most within one or two weeks.

This is due to the destruction of the red cells, with the formation of an excess of bile pigment within the first few days after delivery.

There are, however, other causes of icterus in the new-born and which are often attended with definitely pathological signs and symptoms. Among these may be mentioned the varieties of jaundice which are the result of inflammation, obstruction, severe sepsis and hæmolysis.

Catarrhal Jaundice. It is due to some gastro-intestinal infection at birth. It may be due to the obstruction produced by inflammatory swelling of the mucous membrane of the biliary papillæ. The jaundice that results is more severe in form, the conjunctivæ are tinged yellow, the urine is bile-stained and the stools are clay-coloured. As a result of the enteritis some degree of diarrhœa may be present. It is not attended with any rise of temperature. It generally yields to simple remedies; a teaspoonful of castor oil or $\frac{1}{4}$ gr. of hydrargyrum-cum-creta will probably clear the jaundice.

Obstructive Type. This is generally due to the developmental defects in the bile-duct. The resultant jaundice is very severe, and the condition is usually fatal.

The Septic Type results in a severe form of jaundice known as icterus gravis. It is generally due to septic infection of the umbilical stump. The organisms which gain admission through the stump soon find their way to the liver through the obliterated umbilical vein and give rise to bacteræmia. There is high fever, intense jaundice, clay-coloured stools, and almost invariably the disease ends fatally.

Familial Icterus Gravis Neonatorum. This is a rare variety of jaundice which affects children in the same family and begins within a few hours after birth. The child is drowsy and is not able to suckle at the breast. The stools are normal in colour. The urine is dark and contains bile pigments. It usually ends fatally within a few days, the maximum period being three weeks.

Icterus due to Rh Incompatibility. This is of very grave consequence and is dealt with under hæmolytic disease of the new born.

Hæmorrhagic Disease. During the first few days after birth prothrombin deficiency is common in most babies. It sometimes causes spontaneous hæmorrhage. Common sites of bleeding are the umbilical cord stump, the scalp, the brain, the bowel or the peritoneal cavity. Thus the baby may exhibit signs of melæna, hæmatamesis, bruising or evidence of fluid in chest or abdomen.

If the bleeding is not trivial, vitamin K (1 to 5 mg.) should be given. Transfusion would be indicated in cases of severe hæmorrhage resulting in pallor and shock.

Sepsis and severe hæmolytic jaundice also may be associated with hæmorrhage. Antibiotics should be given if infection is suspected. In presence of jaundice Vitamin K should be used with caution.

Infantile Convulsions. Convulsions in the neonatal period are not infrequent. Convulsions occurring within the first forty-eight hours after delivery are generally due to some damage to the brain which has occurred during the course of delivery. A close scrutiny of the nature of delivery will probably make this clear. They are not infrequent in premature children delivered naturally. They are more common in cases of breech deliveries, particularly with premature infants and in cases of prolonged or difficult labours.

Among other causes may be mentioned :—

- (1) Asphyxia neonatorum.
- (2) Febrile conditions.
- (3) Gastro-intestinal disturbances.
- (4) Developmental errors such as encephalocele, hydrocephalus, microcephalus etc.

Symptoms. Convulsions may occur without any previous warning. They may involve only the face and upper limbs or may be more generalised. In the severe type of convulsions the infant stops breathing, the face becomes blue and turgid and there is a spasmodic contraction of the muscles. Retraction of the head may occur. Convulsions are generally quite short in duration; they may occur again and again in severe cases and may occasionally end in a kind of status epilepticus.

Prognosis depends upon the cause. It is more serious in cases associated with cerebral injury and congenital anomalies.

Treatment. Immediate treatment to control the convulsions consists in loosening any clothing about the infant, and drawing the tongue forward. If breathing has stopped temporarily, artificial respiration should be given. If there is cyanosis oxygen should be administered phenobarbitone 8 mgm., every 6 to 12 hours and intramuscular injections of $\frac{1}{2}$ to 1 ml. of paraldehyde are useful to control the convulsions.

Prophylaxis consists in the care taken to prevention of intra-cranial stress and possible injury in the course of delivery.

In cases due to febrile conditions the temperature should be kept below 102° and the cause treated. Where convulsions are due to

gastro-intestinal causes, suitable remedies should be administered. Dietetic precautions are necessary in such cases.

Infections in the new-born. The *fœtus in utero* is bacteriologically sterile unless the amniotic sac has become infected or organisms have passed through the placenta. Such an infection occurs in labour prolonged for over 24-48 hours after rupture of membranes or where repeated vaginal examinations have been made with scant precautions.

The onset of infection in a neonate is insidious. High fever, tachycardia and evidence of organ involvement are rarely seen. Clinical and radiological signs are minimal. However the changes in the infant's behaviour are common and may give a clue—Coliform organisms and staphylococci are the predominant infecting organisms.

The common sites of infection are the eyes, the skin, and the umbilicus. Pneumonia results from systemic infection. Intra-abdominal infection usually is the result of umbilical infection. Urinary tract infection is common. Meningitis also may result from infection. Once infection is diagnosed the appropriate antibiotics should be administered.

Diarrhœa and gastro-enteritis are very common. The latter is uncommon in breast-fed infants. Dehydration results from diarrhœa and vomiting and in its treatment fluid replacement has priority. Intravenous administration of Hartman's solution (inj. sod. lact. co. B.P.) or isotonic saline is very beneficial the amount administered depending upon the degree of dehydration. Systemic antibiotics are commonly needed.

Tetanus Neonatorum. This should be a very rare disease, but it is still not infrequent in tropical countries. It is almost always due to infection of the stump of the umbilical cord by the tetanus bacillus. The signs are those usually present in cases of tetanus in the adult—spasmodic rigidity of the muscles of the jaw, trunk, and limbs, with difficulty in swallowing.

Sedation with chlorpromazine 15-30 mgms. a day in divided doses supplemented if necessary by paraldehyde injections intramuscularly is useful in controlling spasms. Tetanus, anti-toxin 50-100,000 units should be administered either intravenously or intramuscularly. The mortality from neonatal tetanus is high.

Prophylactic treatment is the best method of avoiding such a severe complication.

Congenital Syphilis. The part played by the mother in transmitting a syphilitic infection to her offspring has been dealt with in

detail in the chapter on diseases complicating pregnancy. It has been stated there that an infant may be born manifesting signs of syphilis, or it may at a later date show evidence of the infection. The extent to which such manifestations occur depends on (1) the severity of the infection in the mother, (2) the time at which the infection occurred with reference to gestation, and (3) the efficiency of any treatment that the mother had during pregnancy.

Syphilis gives rise to characteristic lesions of the fœtus and it also affects the placenta. In cases where the child is stillborn the spirochætæ can be demonstrated in the placenta, the liver, kidneys, adrenals and occasionally in the lungs of the fœtus. The syphilitic fœtus may be undersized and in some cases the skin covering the soles of the feet and the palms of the hand is thickened shiny and peels off easily. The liver is markedly enlarged with interstitial fibrosis and small round cell infiltration. The changes in the bones also are characteristic. They are due to osteochondritis so that there is no sharply divided zone of preliminary calcification between the cartilage and growing bone. These bony changes are detected by X-rays and is therefore an accessory means of diagnosis both intra-uterine and after birth.

The changes in the placenta have been referred to. Usually it is larger and paler in colour, relatively increased in weight in proportion to the fœtal weight so that it may be in the ratio of 1 : 3 instead of the normal 1 : 6.

Clinical Features. A syphilitic infant may show manifestations of the disease at birth. This generally is in the form of an eruption of bullæ or pustules on a dark red base. The skin eruptions may vary in their nature and generally occur within the first three months. They are usually over the napkin area, near the nose and mouth, on the palms of the hands and soles of the feet; they may sometimes occur over the whole trunk and extremities. Condylomata and moist papillæ and ulcerative fissures or rhagades may appear at the angles of the mouth. Simultaneously with the skin eruption the nails may become opaque and irregular. The hair tends to fall out, but in some cases there may be an abundant growth of hair. Syphilitic infants tend to waste and become marasmic. The wasting is independent of any faulty feeding or irregularity of the bowels; and in infants who waste persistently in the absence of the ordinary causes of marasmus the possibility of congenital syphilis should be considered.

Snuffles is an important and early sign of congenital syphilis that can be easily recognised. It usually occurs within the first six weeks. The symptoms vary greatly in degree from a slight stuffiness of the nose to a profuse discharge of pus, sometimes blood-stained. If the snuffles continue for some time, the bridge of the nose may become

depressed, the cry may become hoarse and raucous. Suppurative otitis media is often an early manifestation.

When the disease has been present for some time the infant presents a typical picture with marasmus, snuffles, skin eruptions and other changes consequent thereon. In some cases tertiary lesions develop; they may appear very early or not till the child has grown up. Gummata, interstitial orchitis, tertiary lesions of the mouth and throat, interstitial keratitis, affections of the middle ear and changes in the teeth may all appear at a much later period. These manifestations may affect the bones and the viscera and finally the nervous system.

Diagnosis. The typical skin eruptions, snuffles, wasting, etc., constitute a clinical picture that arrests attention. The diagnosis can be confirmed by the demonstration of the *spirochætæ pallida* in the secretions. If the V.D.R.L. test of the mother's blood is positive, active treatment of the infant is called for.

Treatment. The proper time to undertake treatment with a view either to prevent or abort the attack in the infant is during pregnancy. If, however, this has not been done, or in cases where treatment has been given during pregnancy, but has not been undertaken sufficiently early, it may be necessary to supplement it by anti-syphilitic treatment of the new-born.

A child born of a pregnant woman treated for latent syphilis if free from clinical and serological manifestations need not be treated but should be kept under observation for a period of two years, with serological examination every month. During this period if it develops mucocutaneous or skeletal lesions or the blood becomes positive treatment should be instituted.

A child with congenital syphilis is treated with Penicillin Aluminium Monostearate (P.A.M.) 1 ml. (300,000 units) daily intramuscularly for eight days. If there is liver damage, $\frac{1}{2}$ ml. P.A.M. should be given daily for sixteen days.

These children must be followed up for a period of two years with quantitative serological tests every month. Central nervous system involvement should be excluded by examination of the cerebro-spinal fluid. If there is a rise in titre or clinical relapse, another course of P.A.M. should be given.

Combined with this anti-syphilitic treatment, hygienic measures should be followed and the child carefully nourished.

CONGENITAL MALFORMATIONS

MALFORMATIONS of the foetus may vary from trivial defects to grave deformities incompatible with life such as anencephalous. It is stated that about one per cent of all foetuses alive at the twenty-eighth week of pregnancy die from congenital malformations within the first year of birth. They are thus an important factor in the causation of perinatal deaths. Most of the malformations incompatible with life involve the central nervous system—anencephalous or hydrocephalous with or without spina bifida.

There are many minor defects which are compatible with life of which some are very minor and others of clinical significance requiring correction by surgical procedures and may be serious though compatible with life. These include congenital heart disease, hare-lip, cleft palate, pyloric stenosis, tracheo-oesophageal fistula, imperforate anus, hypospadias, club foot and other bony deformities.

The incidence of congenital malformations may be affected by maternal age, parity, race and sex of the infant. The most striking effect of age on the frequency of congenital deformities is seen in mongolism which is more common in mothers over 35. Hydrocephalous is more frequent in older gravidas. In general, malformations of the central nervous system are somewhat more common at the beginning of the reproductive period and after 35 years of age. There is evidence that irrespective of age, first birth and those after the sixth are more likely to be associated with anencephalous and spina bifida. The occasional relationship between foetal sex and malformation is exemplified by anencephalous in which 70% so affected are female. Once a mother has given birth to a malformed child, there is an increased likelihood of it recurring in subsequent pregnancies. Following spina bifida, the risk of spina bifida in subsequent pregnancies is about 12 times greater than in the general population. The risk of anencephalous is about 6 times greater. Hydrocephalous without spina bifida is much less likely to recur. Congenital malformations are often multiple and the presence of one deformity should always lead to suspicion of others. Spina bifida is a common association of hydrocephalous. If during a breech delivery spina bifida is discovered, it should always suggest the possibility of hydrocephalous.

Major genetic causes can be found as ætiological factor in a small number of congenital malformations. Major environmental factors

also may be a factor in some malformations. Most of them are perhaps the result of interreaction of genetic and intra-uterine environmental factors. The most familiar example of environmental factor in malformation is maternal rubella during early pregnancy which produces, congenital cataracts, cardiac defects and anomalies of the middle ear. Defects of the central nervous system may be caused by radiation. There are also drugs which cause malformations. Among the few drugs known to be definitely teratogenic are certain antifolic acid compounds and thalidomide. In addition some progestational compounds masculinize the human fœtuses. Chromosomal anomalies also give rise to malformations—examples of such chromosomal anomalies are, Down's syndrome, Turner's syndrome, Klinefelter's syndrome. The Obstetrician may suspect many of these abnormalities at birth of the infant. A single umbilical artery is often seen in association with malformations.

Among the more important of the anomalies from the obstetric point of view may be mentioned—

- (a) Anencephalus,
- (b) Hydrocephalus,
- (c) Fœtal ascites,
- (d) Double monsters.

Anencephalus. In this condition the head is imperfectly developed, particularly the vault of the skull and the brain. Most of these fœtuses are stillborn. A few may be born alive but die within a very short time. The brain is in a rudimentary condition, and owing to the absence of the cranial vault, the base of the skull can be easily felt, so that even the sella turcica may be distinguished. The fœtus generally presents as a face presentation in view of the abnormal shape of the head.



FIG. 139.—Anencephalic Fœtus.

Hydramnios is frequently associated with this condition. Anencephaly and post-maturity are found in association to a significant degree.

Inability to palpate a foetal head abdominally and the presence of hydramnios should arouse the suspicion of anencephalous which should be confirmed by radiological examination.

The diagnosis can also be confirmed by vaginal examination during labour.

The most frequent problem posed by a pregnancy complicated by anencephalous is whether to induce labour as soon as it is diagnosed or await spontaneous onset of labour. There is no harm in inducing labour by intravenous oxytocin drip. But it has to be borne in mind that the uterus containing an anencephalic foetus is often refractory to oxytocic stimulation. If intravenous oxytocin fails, intra amniotic injection of hypertonic dextrose or saline as described elsewhere may succeed. There is no harm however in awaiting spontaneous onset of labour except that these patients are mentally disturbed when they come to know that the foetus is malformed. Naturally they do not like to keep such a foetus in utero.

Delivery is usually uncomplicated, excepting for the fact that in some cases the shoulders are bigger than normal and may become impacted necessitating cleidotomy before delivery of the foetus is accomplished.

Hydrocephalus. This is a condition where the ventricles of the brain are distended with an excessive amount of cerebro-spinal fluid. Various degrees of hydrocephalus may be met with, and in some cases the hydrocephalic head may fill the greater part of the uterine cavity. The foetus may present either by the cephalic or the podalic pole. If cephalic the enlarged head distends the lower uterine segment.

The diagnosis of a hydrocephalus is not always easy, and the condition may not be recognised till the woman has been several



FIG. 140.—Hydrocephalus.

hours in labour. Hydrocephalus should be suspected when a head remains unduly high despite a normal pelvis and good uterine action and when a floating head feels unusually broad and soft. When the

cervix is dilated and a vaginal examination is made, the widely gaping sutures and the large fontanelles present a typical picture. 'Islands of bones in a sea of membranes' tell their own tale. In breech presentations careful abdominal palpation may reveal the presence of the large, ill-defined and somewhat fluctuant head. In many cases, however, it is not till the breech is delivered upto the neck that the possibility of a hydrocephalus suggests itself because of the enlarged size of the uterus, together with difficulty in extracting the head.

X-ray in Diagnosis. X-ray of the fœtus will help in the diagnosis when the unduly large size of the head and the islands of bone will be revealed.

Prognosis. The fœtal prognosis is bad. Frequently the fœtus is delivered stillborn. Even when born alive, its survival is a question of days. Cases of hydrocephalus which survive develop a hopeless form of mental deficiency.

So far as the maternal prognosis is concerned, much depends upon the treatment adopted. If a diagnosis is not made and proper treatment resorted to, or if the case is left to nature, rupture of the uterus is inevitable and death of the mother will most probably result. When proper treatment is adopted and the delivery is conducted in as conservative a manner as possible, taking into consideration that the fœtal prognosis is hopeless, there should be no increased risk of a pronounced nature to the mother.

Treatment. When labour has begun and the cervix is dilated to admit two or three fingers, the head should be perforated in vertex presentations. Immediately this is done, a large amount of fluid gushes out and the skull collapses, after which delivery may be left to natural efforts. When the fœtus is presenting by the breech, a simple method of expediting delivery is to tap the spinal canal and so drain off the fluid. If the child has been delivered upto the neck, the head may be tapped through the base of the skull or perforated. In some cases it has been suggested that tapping through the spinal column may be resorted to as a means of saving the life of the fœtus. How far this is a justifiable procedure in pronounced cases of hydrocephalus is a matter for serious doubt.

Fœtal Ascites. Enlargement of the body of the fœtus due to fluid in the thorax or the abdominal cavity very often leads to difficulty in delivery. The fœtus in such cases usually presents by the breech, and as soon as the lower extremities have been delivered and difficulty is encountered in the further delivery, a careful vaginal examination will reveal the tenseness of the abdominal cavity or of

the thorax. The question of the life of the fœtus does not arise in such cases, as the fœtus is invariably dead or dying. A sharp hook



FIG. 141.—Fœtal Ascites.

passed into the fœtal abdomen will generally allow the fluid to drain away and the rest of the delivery is fairly simple.

Double Monsters

Double monsters or conjoint twins are of considerable interest both from the obstetrical and embryological points of view. Different types of such monsters are met with ranging from two fully developed separate fœtuses joined together, to monsters where the greater part of the anatomy is fused. Various classifications have been adopted to differentiate the many varieties of double monsters. From a clinical point of view, however, double monsters may be (a) where both components are more or less of equal size and united in parts, and (b) where one of the components is fully developed and has attached to it a portion of the second twin. From the obstetric point of view the second of these categories does not cause any significant obstruction. Fully developed double monsters, however, are a source of great difficulty in labour and require considerable skill to effect their delivery without damage to the mother. Such double monsters may be further classified as follows :

- (i) **Synencephalic Monsters.** These are fused at the cephalic pole, so that the fused heads present the appearance of a single large one. The majority of monsters are, however, dicephalic, that is, the two heads are separate.
- (ii) **Thoracopagic Monsters.** In this category the two monsters are fused at the thorax. The fusion may be limited to the thorax or may extend in part or whole to the abdominal cavity as well. Thoracopagic monsters are

dicephalic and, depending upon the number of the upper and lower extremities, they may be dibrachius, tribrachius, tetrabrachius and dipes or tetrapes.

- (iii) **Ischiopagus.** Herein the monsters are fused in the pelvic region. Many different varieties of such fusion may occur.

Labour complicated by Double Monsters. Of the many varieties of double monsters, the dicephalic thoracopagi gives rise



FIG. 142.—Thoracopagus.

to the greatest difficulty in labour. The diagnosis is not generally made antenatally unless an X-ray has been taken. More often such cases are mistaken for twins, and it is only when the woman is actually in labour and there is difficulty in delivery that suspicion is first aroused. A careful internal examination at this stage will reveal the true cause of the dystocia. There are, however, several authentic instances on record of thoracopagi where natural delivery has presumably occurred and the conjoint twins have survived in some cases for years. Sometimes both the component halves of the double monsters may present by the breech, the body which is fused may be delivered without much difficulty, and then the first head enters the pelvis and is delivered by pulling the body well forward towards the mother's abdomen,

after which the second head usually finds its way out. More frequently, however, the delivery of the cephalic pole presents considerable difficulty, and in such cases it may be necessary to decapitate one of the heads before the other can be delivered. After the delivery of the fœtus, the decapitated head can be expressed.

Cæsarean section undoubtedly offers a safer method of delivery both for the mother and for the fœtus, and should be done in those cases where the diagnosis is made sufficiently early and the thoracopagic twins are fully developed.

In cases of synencephalic double monsters the difficulty is experienced in the delivery of the large head and may necessitate perforation before it can be extracted. In cases where the patient is seen late in labour and the cause of obstruction is due to a double monster, delivery may be attempted through the vaginal route by performing embryotomy. A safer method, if difficulty is experienced, is to deliver by cæsarean section and hysterectomy if necessary.

SECTION VIII

OBSTETRIC OPERATIONS

CHAPTER LII

THE FORCEPS

THE obstetric forceps is an instrument designed for the extraction of the head of the child, provided certain conditions are present which make the operation safe. It is one of the most useful of instruments in the obstetrician's armamentarium, but unfortunately by its abuse it is also one of the potent causes of damage to the mother and the child.

The history of the invention of the obstetric forceps and its subsequent development is interesting, and the reader is referred to the detailed account given in 'THE HISTORY OF THE OBSTETRIC FORCEPS' by the late Sir Kedarnath Das.

The obstetric forceps consists of two blades, which cross each other and are called the left or lower blade, and the right or upper blade, according to the side of the pelvis to which they are applied. Each blade is made up of four parts; the fenestrated blade proper, the shank, the lock, and the application handle. In some types there is, in addition, traction rods and a traction handle. Each fenestrated blade possesses two curves, a cephalic curve, which enables the blade to be applied closely to the cephalic pole of the fœtus, and a pelvic curve, which enables it to be introduced so as to lie more or less in the axis of the parturient canal. The two blades articulate at the lock, which may be of the English type or the French type. The English type is the simpler and more efficient of the two, and allows the shank of one blade to slip into the socket of the other. In the French lock a pivot is screwed into the shank of the left blade, while in the right blade there is a notch which can be adjusted to it, the screw being tightened after locking the blades. These are called the straight forceps of

which there are many varieties. Simpson's forceps is a commonly used forceps. One of the most striking advances in the evolution of the obstetric forceps is the invention of axis traction by Tarnier in 1877, and it may be said that since that date no great improvement has really been effected. With the straight forceps, traction becomes difficult if the head is in the midcavity. The addition of traction rods, which enables traction to be applied in the axis of the pelvic cavity has overcome this difficulty. Hence, whenever forceps has to be applied when the head is still above the level of the ischial spines, axis traction forceps may have to be employed.

The common forms of axis traction forceps now in use are the improved Tarnier's, Milne Murray's axis traction forceps, and Neville's axis traction forceps. It is a matter of personal taste which particular form of axis traction forceps is used. We prefer the Milne Murray's axis traction forceps, as we find it suitable for all types of forceps delivery.

The Choice of Forceps. The obstetrician cannot be too careful in the choice of an obstetric forceps. We regret to state in this connection, owing to the tendency for mass production of instruments, there has been a considerable deterioration in the standards that ought to be maintained in the manufacture of such an important instrument. It is well, therefore, to test each instrument and make sure that it is properly finished; that it conforms to particular measurements; that it locks properly; that the axis traction rods do not slip out easily; that the traction handle can be applied without much difficulty, and that it is made entirely of metal and well annealed. To test whether the forceps satisfies the requirements it is well to note certain measurements—the maximum distance between the two blades should not exceed 7.5 cm. or 3 ins., when the forceps is articulated; the distance between the tips should be 2.5 cm. (1 in.); the cephalic and pelvic curves should be of proper proportion; when the forceps is placed upon a plane surface, the tips of the blades should be about 8.8 cm. (3½ ins.) higher than the handles.

The forceps ordinarily available in the market is a little too heavy and too large to suit the requirements of the short-statured Indian women. For this reason Kedarnath Das has patented a forceps—the Das Calcutta forceps—which is much lighter and smaller and is specially suitable for use in India.

Indications—Changing Trends. Strictly speaking, the indications for delivery by forceps are only (1) fetal distress and (2) maternal distress. At times both may be present. These indications were rigidly adhered to until a few years ago because of the fear of puerperal infection which was more common in operative deliveries.

Prior to the advent of chemotherapy and antibiotics, forceps delivery was resorted to only on definite indications, namely maternal or foetal distress. The dread of puerperal infection, especially following an operative delivery, and the heavy maternal mortality associated with such infection made it imperative that the obstetrician resort to operative delivery strictly on clear indications. This attitude of mind, while inevitable, resulted in serious complications to the infant in that severe asphyxia, intracranial damage and neonatal deaths from prolonged labour took a heavy toll of the infant at birth. The dread of infection and shock in caesarean section done late in labour made the obstetrician avoid caesarean section and prefer high forceps to abdominal route delivery. It was not uncommon in those days to put on forceps with the head still high, the greatest diameter not having gone through and combine the operation with manual dilatation of the cervix in cases of prolonged obstructed labour. Perforation was resorted to if attempts at delivery failed. The aim was to avoid caesarean section as maternal mortality was high in caesarean section.

The advent of antibiotics, chemotherapy and blood transfusion rendering marked degree of safety to the mother not only in vaginal operations but also for caesarean section done late in labour, the better understanding of the problems of asphyxia in the new-born, the appreciation of the aftermath of obstetric trauma to the mother and the child have brought about a change in the indications and technique of forceps delivery. In modern obstetrics foetal or maternal distress is not permitted to develop and good obstetrics consists in anticipating such distress and completing the delivery with no trauma to the mother or the child.

The Prophylactic Forceps. As stated previously, foetal distress is not permitted to develop. Hence, once the head has come on to the pelvic floor even if there is no foetal or maternal distress, if maternal efforts have not been able to complete the delivery within half an hour, the delivery is completed by forceps. The term elective or prophylactic forceps has been used to indicate delivery by forceps when there are no strict indications and the term 'indicated forceps' is used when it is applied only on indications. The reason for elective forceps is the appreciation over years, of the damage that could be done to a baby's head if it is left on the perineum for a long time and also to the pelvic floor by the continued pressure of the head.

Maternal diseases may sometimes necessitate the use of forceps to save the mother from exhaustion. It is customary in patients with heart disease, anæmia, toxæmia, antepartum hæmorrhage and in those suffering from malnutrition and acute illnesses, to cut short the second stage of labour as soon as it can be done easily and with no trauma to the mother or the child.

Apart from foetal distress, progress in labour may come to a standstill due to faulty position of the foetal head and hence may necessitate help with forceps to complete the delivery. The arrest of rotation in-occipito-posterior and occipito-transverse position of the head is a common indication for forceps delivery. Face and brow presentations are by themselves not indications, but require forceps delivery more often than vertex presentations.

Forceps to the after-coming head in breech delivery is resorted to as a routine in certain clinics but we resort to it only if simple measures fail.

All said and done, in over 70% of cases, the indication for forceps is failure of the secondary forces in labour. In these cases the head has come down to the perineum. It may be the head is too big for the outlet, or the perineum too resistant. In any case, labour comes to a standstill, the pains weaken, and sometimes the woman even turns on her side and lies with the head visible at the vulval outlet. Under such conditions, it is far better to complete the delivery by forceps rather than wait till maternal exhaustion or foetal distress supervenes.

The diagnosis of foetal distress has been discussed in the chapter on 'asphyxia neonatorum.'

Conditions to be Satisfied before the Application of Forceps.
These are :—

- (1) The cervix must be fully dilated and taken up.
- (2) The membranes must be ruptured.
- (3) The presentation should be a cephalic presentation.
- (4) The greatest diameter of the head should have passed through the brim of the pelvis, and there must be no disproportion between the foetal head and the pelvis anywhere in the cavity or outlet.
- (5) The bladder and rectum should be empty.

Method of Application. The technique of the application of forceps must be thoroughly understood by the obstetrician. Failure to extract the head, damage to the foetal head, lacerations of the maternal soft parts and the increased incidence of morbidity in the puerperium are in the majority of cases due to faulty technique. The bladder should always be emptied by the passage of a rubber catheter, or if this is not successful by introducing a metal catheter. The operation is best performed under pudendal block anaesthesia ; general anaesthesia may be necessary on occasions.

The patient should be brought to the edge of the bed and made to lie in the dorsal posture, with the legs supported mechanically or by assistants. The operative field is then covered with sterile towels or sheets. Whether to apply the ordinary straight forceps or an axis traction forceps depends upon the position of the head with reference to the pelvic cavity.

There are two ways of applying forceps:—

- (1) The cephalic method, and
- (2) The pelvic method.

In the *cephalic method* the blades are applied at either ends of the biparietal diameter when each ear will be in the centre of each fenestra of the forceps. This causes compression in the biparietal diameter where it does the least harm, also with a cephalic grip the blades fit much better and do not tend to slip. To do this successfully requires a careful appreciation of the position of the foetal head with reference to the pelvis and the accurate adaptation of the blades to the sides of the foetal head, irrespective of its position in relation to the maternal pelvis.

In the *pelvic method* the blades are applied with reference to the maternal pelvis, one being placed on the right side and the other on the left side. If the occiput has not fully rotated to the front pelvic

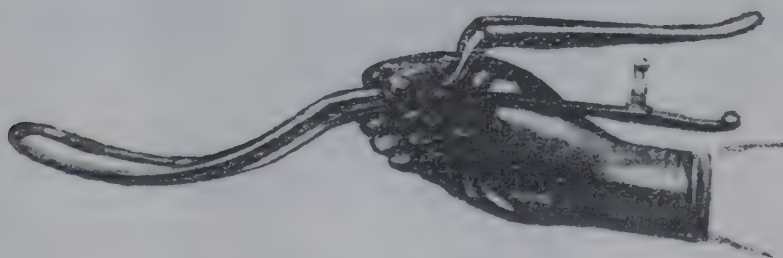


FIG. 143.—Forceps application.

Method of holding the left or lower blade before application.

application of the forceps may cause undue trauma to the foetal head during traction as it will be compressing larger diameters of the foetal skull. Such compression in an unfavourable diameter may cause intra-cranial hæmorrhage. Hence pelvic application should be avoided in all cases where the occiput is not anterior. However once full rotation has taken place or brought about by manual methods pelvic application can be carried out as the blades of the forceps will be catching the foetal head only in the biparietal diameters. If rotation with forceps is contemplated, application should always be cephalic.

We describe a forceps delivery with the head at the level of the ischial spines using an axis traction forceps. The head has completely

rotated into O.A. with the sagittal suture lying in the antero-posterior diameter of the outlet. Many techniques of application are described all good in their own way. The obstetrician by experience must evolve his own technique. Whatever the technique employed, the fundamental principles involved are the same—to complete delivery with minimum trauma to the mother and the child.

Introduction of the Blades. With the patient anæsthetised and the parts carefully prepared, the operator sits on a stool of convenient height, and after having emptied the bladder by passing a catheter, takes the left or lower blade in his right hand. He introduces two fingers of his gloved left hand into the vaginal cavity on the right and posterior quadrant of the pelvis, so that the palmar surface of the fingers are looking upwards and to the left. The lower blade is lightly held with the axis traction rod in intimate contact with the handle in

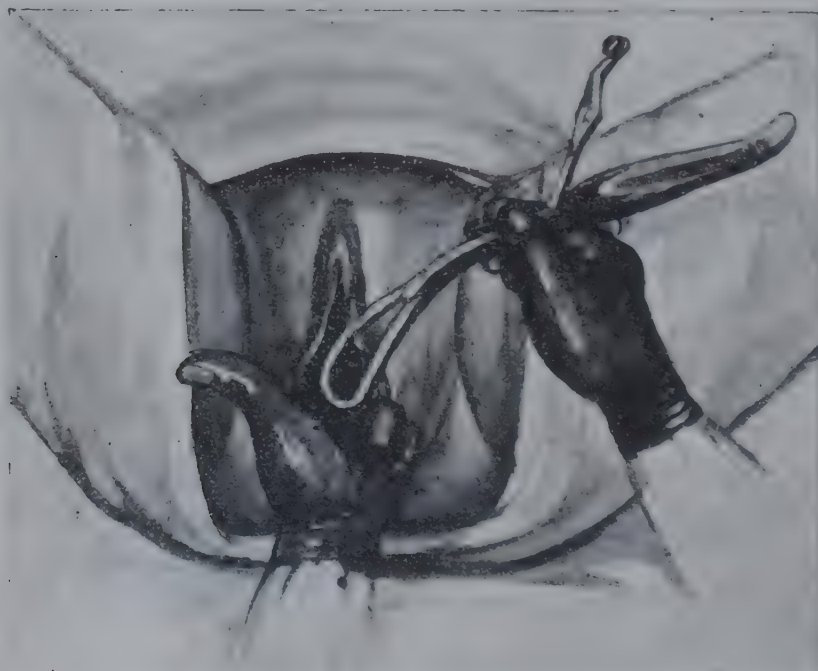


FIG. 144.—Forceps application. Method of introduction of the left blade.
Note the two fingers in the vagina.

the right hand, as one would hold a spoon. The tip of the blade is held at right angles to the palmar surface of the fingers in the vagina and gently slipped along the fingers into the vaginal cavity, first as a posterior blade, and then when the whole of the cephalic portion of the blade has been introduced it is gently rotated laterally to make it the left blade. The two fingers passed into the vagina are to direct the blade of the forceps along the vagina and to see that the blade is in close apposition to the head. It is not necessary to introduce the half hand into the vagina for slipping in the blades of the forceps. We hold further that the introduction of the half hand very often pushes the presenting part upwards and thus converts a low-forceps into a mid-

forceps and a mid-forceps into a high-forceps. That the lower blade has been correctly applied can be verified by pressing the handle well against the perineum, when if the handle is seen perfectly straight without any slight tilting to one side or the other, it can be presumed to have been properly applied. Should the lower blade have been applied properly, it will rest there and not tend to slip out. An assistant may, if necessary, lightly steady the handle in this position. The operator then removes his left hand and introduces the same two fingers, but this time above and to the right, so that the palmar aspect of the two fingers is facing downwards and towards the left. The right blade is taken in the right hand, the handle being gripped, and the axis traction

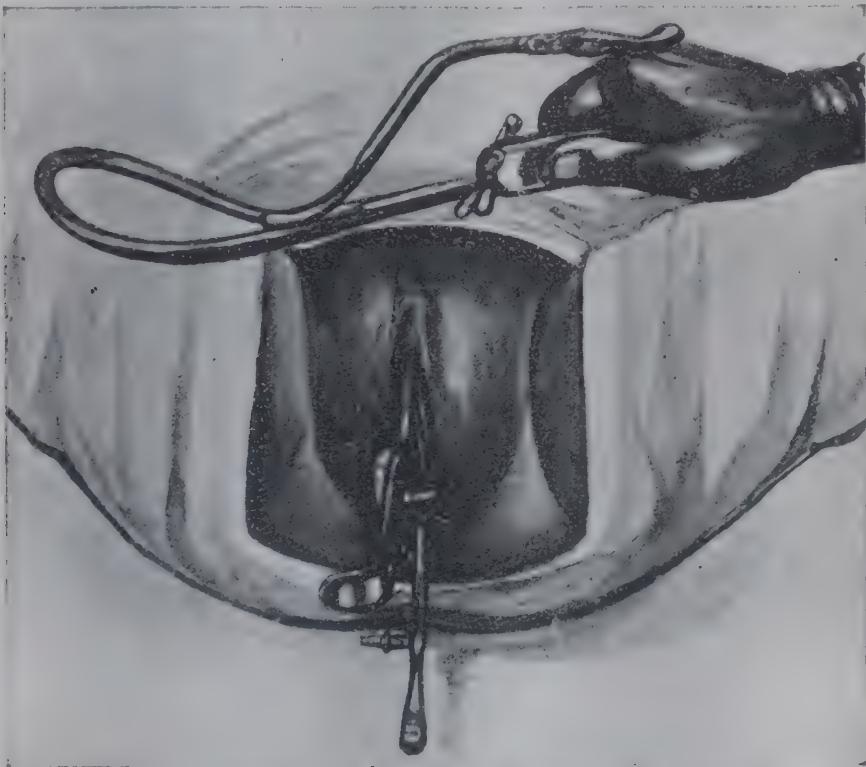


FIG. 145.—Forceps application. Method of holding the right or upper blade : the left blade is *in situ*.

rod made to rest lightly on the knuckle of the mid-finger. The blade is now held parallel to the mother's abdomen, the tip being pressed against the palmar aspect of the two fingers, and by gently rotating through half a circle, the cephalic portion is gradually inserted into the vagina to lie in close apposition with the head. As the blade passes through half the circle it will be generally found that it slips into the right side and adapts itself to the cephalic pole.

Locking of the Forceps. As soon as the blades have been introduced, the forceps should be locked. Considerable difficulty is occasionally experienced in locking the blades ; but if it is kept in mind that the proper thing to do is to bring the right blade to meet the left blade and never to alter the position of the left blade, locking of the

blades will be found easier. Another point to remember is that both the handles should be pressed well posteriorly against the perineum and again locking will be easy. Occasionally, it will be found in occipito-posterior positions that even after locking of the blades the handles do not come exactly in apposition with each other throughout the whole length.

After locking the blades and before the fixation screw is applied, the axis traction rod of the right blade should be carried posteriorly

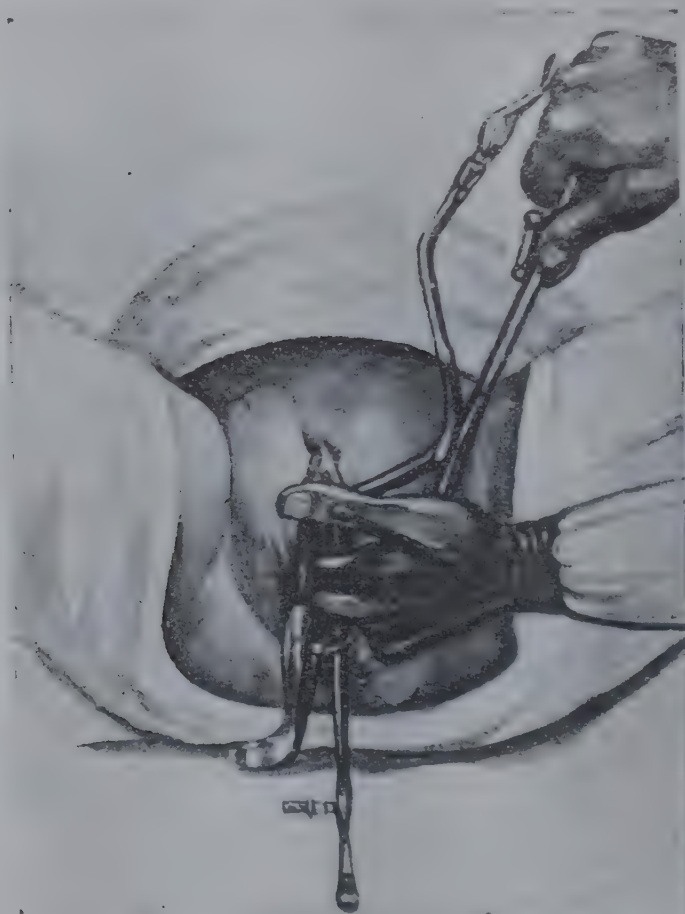


FIG. 146.—Forceps application.

Methods of introduction of the right or upper blade.
Note the position of the axis traction rod of the upper blade resting on the knuckle of the mid-finger.

past the left handle and pressed towards the perineum to meet the axis traction rod of the left blade. The screw is then tightened, the axis traction rods locked, and finally traction handle applied. The forceps is now applied and it is desirable at this stage to make a careful vaginal examination to ascertain that the blades have been properly introduced and fitted against the cephalic pole, and that no part of the cervix has by accident been caught within the blades of the forceps.

Having satisfied himself about this, the obstetrician can now proceed with traction.

Traction. Traction should be applied through the traction handle, keeping the traction rod parallel to the shank. The force employed should never be greater than what the flexed forearm can exert. Generally it is advisable to pull during a pain, and between pains, the traction screw which is only lightly fixed, is unlocked for a short interval to relieve compression of the head within the blades of the forceps. Usually two or three pulls will bring the head on to the perineum, and from this point very little force is required to complete the delivery. When the occiput has emerged from under the symphysis the blades may be removed and the delivery completed in the manner described in the chapter on the management of normal labour. Episiotomy is most often necessary in a primigravida.

In removing the blades, care must be taken to see that this follows the law of curves, the right one being carried towards the left side and

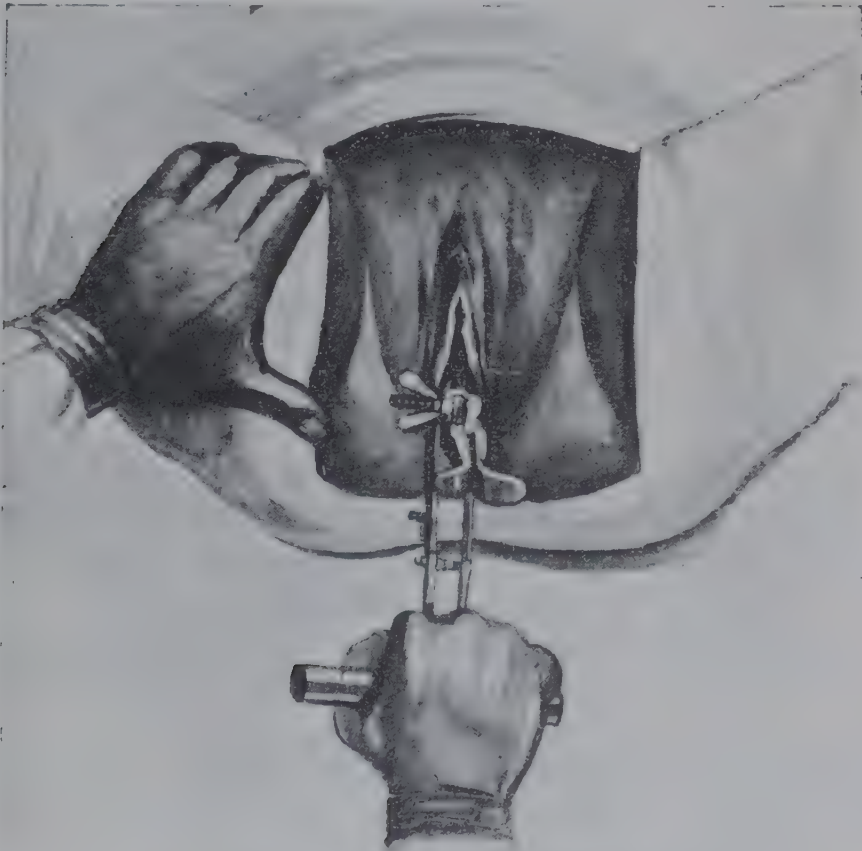


FIG. 147—Forceps application.

Method of traction after locking of the forceps

the left one towards the right side. Some obstetricians prefer to complete the delivery with the forceps *in situ*, as they hold that a greater control over the advance of the head can thus be obtained.

After delivery of the head, the shoulders are delivered and the rest of the body slips out.

In every case where forceps is applied all the necessary accessories for the treatment of asphyxia neonatorum should be ready for immediate use.

The management of the third stage of labour and any necessary repairs of the perineum, etc., have been dealt with previously.

Varieties of Forceps Application. Forceps operations are divided into low, mid, high, floating and forceps for the after-coming head.

(1) Engagement of the head means that the plane of greatest diameter of the head which is the biparietal has passed through the inlet and that therefore the lowermost part of the skull has reached or is below the level of the ischial spines. Low forceps is the application of forceps when the bony portion of the head is resting on the pelvic floor. Occasionally a caput may be seen resting on the pelvic floor while the bony portion of the skull is in reality above the level of the ischial spines. This is not low forceps.

(2) When the head has engaged but the lowermost part of the fetal skull is at or just above the level of the ischial spines it is termed mid forceps.

(3) High forceps is the application of forceps before engagement has taken place. Low forceps deliveries are often referred to as outlet forceps. In modern obstetrics outlet forceps constitute the bulk of forceps delivery.

(4) Forceps to a floating head should not be considered in obstetrics.

Changing trends in obstetrics have led many an obstetrician to discard mid or high forceps deliveries in favour of cæsarean section. The result of this change has been that there has been a considerable fall in the incidence of midcavity and high forceps deliveries. For such deliveries it was necessary to use axis traction forceps as the advantages of traction in the axis of the pelvic cavity are obvious. Once the head has come to the outlet it is unnecessary to employ axis traction forceps as the ordinary straight forceps more than meets the requirements. Therefore for outlet forceps delivery the straight forceps is employed and when the head is at or above the level of ischial spines either axis traction forceps or Kielland's is employed. There is no harm or objection for using axis traction forceps when the head is at the outlet, but it is unnecessary when the straight forceps is easy to use and effective at this level.

Slipping of the Forceps. The forceps may slip when traction is applied. The conditions under which this accident occurs are:—

(1) Faulty application. When the forceps is applied too low on the head, it never grasps the head properly, so the blades may slip.

(2) In certain cases of occipito-posterior position, the forceps does not get a good grip of the fetal head, if a pelvic application is used, and there is always a tendency to slip, unless care be taken to favour rotation of the head before traction is applied.

(3) When applied to a hydrocephalic head, forceps generally tends to slip. It is obvious that in severe degrees of hydrocephalus, the head is too big for the forceps to be applied properly, and a grip over a small portion of the cephalic pole only is obtained.

(4) Occasionally, in cases of rupture of the uterus, forceps may tend to slip as the head recedes.

(5) When applied to a small head or a macerated fetus, the forceps tends to slip.

Such slipping is the result of wrong selection of cases or wrong technique of application.

The slipping of the forceps is an unfortunate and dangerous accident. The sudden stretching of the vaginal walls causes severe laceration of the vagina and the perineum.

Failure to deliver by forceps is also due to the same factors.

Forceps in Occipito-posterior Positions of the Vertex. This subject has been referred to already in the chapter on occipito-posterior position of the vertex. It is generally advisable to rotate the occiput anteriorly before the application of forceps is made. This manœuvre can be done by introducing the half hand and rotating the occiput forwards. The occiput is then steadied and the forceps applied and delivery completed. Sometimes, however, this manœuvre does not succeed, for example, in a case seen late in labour when the head has become jammed in the pelvis and a large caput has developed. The question then is how to effect delivery with forceps.

When manual rotation fails in these cases of occipito-posterior or transverse positions, delivery by rotation with forceps should be attempted. It is very necessary that a cephalic application should be made as otherwise severe intra-cranial damage will result. A large caput succedaneum which is often present in these cases may obscure landmarks which help in identifying the position of the fetal head correctly. Hence, for a correct application of the blades, the half hand should be introduced into the vagina and the posterior ear located. The posterior blade should be applied accurately over the posterior ear and the upper or anterior blade exactly opposite to it. The head is thus gripped in the biparietal diameter. Gentle traction and rotation of the occiput to the front is now commenced. Sometimes the blades begin to rotate on their own once the traction and rotation has been

started. If this happens it should be encouraged. When rotation is completed by forceps, the blades may be seen at times lying antero-posteriorly when they should be removed and re-applied as in an outlet forceps.

In some cases, if traction is applied without carefully noting the tendency for rotation, the head may slip out suddenly and be born as a persistent occipito-posterior, with the face towards the pubis. If this happens there is a greater tendency for severe lacerations of the perineum to occur and the foetal head also is more susceptible to damage.

Forceps in Face Presentations. Where the chin is anterior, spontaneous delivery is most likely. Occasionally, however, for the same reasons which delay an occipito-anterior position, a mento-anterior case may require help with forceps. Some care and delicacy in manipulation are necessary in the introduction of the blades, as the soft parts of the foetal face are liable to be damaged. The place of forceps in mento-posterior cases has been debated at length. Every effort should be made to favour anterior rotation of the chin before application of the forceps, but cases have occurred in one's experience where this has failed to take place. When manual rotation has failed, forceps may be applied and traction with rotation of chin to anterior position attempted. Great care is necessary in this procedure. The forceps may have to be removed and re-applied before delivery is completed, just as in forceps rotation of occipito-posterior positions of the vertex. Rotation with forceps in mento-posterior cases does mean a greater risk of injury to the soft parts of the face. Such injuries may be serious and sometimes lead to permanent damage.

Forceps in Brow Presentations. Forceps should not be used in a brow presentation until the brow has been converted into a face or a vertex presentation.

Forceps to the After-coming Head. In considering the management of cases of breech presentation, we have referred to the use of forceps for delivery of the after-coming head. The forceps may be applied to the after-coming head in one of the two ways :—

(1) The body of the child may be carried upwards towards the mother's abdomen and the blades of the forceps introduced, below the trunk. The operator then applies traction on the forceps.

(2) Occasionally the forceps may have to be applied in front of the trunk, in those cases where the occiput is posterior.

Forceps to the Decapitated Head. In some cases forceps may have to be applied to deliver the decapitated head. Usually, the deca-

pitated head can be easily delivered by fundal pressure, and a finger introduced into the mouth in a manner similar to delivery of the after-coming head of a breech presentation. When this fails it is advisable to grasp the head with a volsellum, steady it by fundal pressure and apply forceps. If the head cannot be delivered with easy traction, there should be no hesitation in perforating the vault of the skull and then delivering the head. If there is still difficulty, a cranioclast must be applied.

Prognosis in Forceps Application. If cases are properly selected, the risks to the mother and child are negligible. A difficult forceps delivery may at times cause trauma to mother and child. Lacerations of the vagina, tears of the cervix extending sometimes even to the lower uterine segment, injuries to the urethra, bladder or rectum may all result from injudicious use of forceps. Traumatic postpartum hæmorrhage and latter puerperal infection may follow. Damage to the pelvic floor may give rise to utero-vaginal prolapse, tears of the cervix to chronic endocervicitis and if badly traumatised to atresia in later life. Subluxation or fracture of the symphysis pubis with resultant difficulty in locomotion may also occur. These are some of the late sequelæ of a difficult forceps delivery.

For the child the dangers are commonly intra-ranial hæmorrhage, at times fracture of the skull, injuries to the scalp and facial paralysis due to compression of the facial nerve by the blades.

These damages to mother and child be it remembered result only from injudicious use of the instrument.

The remote risks are due to the lacerations of the vagina and perineum which produce a relaxation of the pelvic floor and favour the development of cystocele, rectocele and uterine prolapse. Tears of the cervix may lead to chronic cervicitis, atresia or chronic pelvic inflammatory trouble.

Kielland's Forceps. In 1915, Kielland of Norway introduced a new forceps which has been widely used in Germany and Scandinavia. The advantages claimed for this forceps are :—

1. The head is always grasped in the biparietal diameter and hence in the subsequent traction there will be no slipping of the forceps. The application is always cephalic.
2. Forceps rotation of the head is safe as the blades fit the head closely and there is no possibility of slipping.
3. Such pressure as is inevitable in the application of this forceps is made on the part of the foetal head which can best resist it, so that the cheeks, the underlying bones, the orbits, chin, etc., are not affected,

and the inevitable trauma to the soft parts, to nerves and brain does not therefore result.

4. Another advantage claimed is that the presenting part is not displaced by the introduction of the blades, and that as less forcible traction is necessary for the delivery, the risk of maternal injuries is minimised.

The forceps itself consists of two blades which are articulated by a slot on one of the blades into which the other blade slides. The absence of any locking arrangement, as in the ordinary forceps, is significant and the method of articulation is the most characteristic feature of this instrument, allowing one blade to slide longitudinally along the other. The advantage of this is that the head may be grasped by the blades lying at different vertical levels. There is a very small pelvic curve so that the blades resemble the old model of straight forceps. The cephalic curve is almost similar to that in the ordinary Simpson-Barnes' forceps.

The method of application of Kielland's forceps is as follows :—

The patient is placed preferably in the dorsal position, with the buttocks well over the edge of the table ; and after the usual antiseptic precautions have been taken and the parts protected with sterile sheets, the bladder is emptied by passage of a sterile catheter and the patient anæsthetised. The position of the head is well defined.

The anterior blade is now taken in the right hand and two fingers of the left hand inserted into the vagina, so as to pass beyond the anterior lip of the cervix and underneath the symphysis pubis. The blade is introduced horizontally, the fingers guiding it into position with the concavity of the foetal curve facing the pubis.

The blade is passed well into the vagina until the tip of the blade touches the skull and then onwards well inside the uterus, but with no force, until the middle round part of the shank lies under or behind the symphysis pubis. The vaginal fingers are now withdrawn and the anterior blade is rotated on its long axis.

The rotation is done through 180° towards the side on which the button is situated on the forceps blade. The anterior blade is thus applied automatically with its tip over the malar bone of the foetal head. The blade is left *in situ* without any artificial support.

The second or posterior blade is now guided by two fingers passed into the vagina between the posterior cervical lip and the head. The blade is gently passed to the side of or in front of the sacral promontory. The blades are now locked, and as the lock is so constructed that it will be effective even if one blade is higher than the other, little

difficulty will be found in this procedure. The forceps is now in the antero-posterior diameter of the pelvis and has grasped the head at the ends of the biparietal diameter. Gentle traction and rotation of the occiput to the front is commenced. Minimum force only must be employed and the traction and rotation should be intermittent. Delivery is often completed after an episiotomy.

The method of application described is the classical method described by Kielland. Its greatest disadvantage is that, in delayed cases, the anterior blade may during its application traumatise the lower uterine segment.



FIG. 148.—Kielland's forceps: showing (a) the introduction of the Anterior blade; (b) position of the blade after rotation.

Many obstetricians therefore resort to what is known as the 'wandering method'. The anterior blade is held lightly in the fingers and thumb of the right hand, the handle of the blade is depressed almost to a vertical position when it will be possible to introduce the blade into the vagina along the palmar surface of the left hand until the tip reaches the foetal scalp. The blade is then glided upwards until it comes to lie along the side of the head. The application of the posterior blade is usually easy. It is gently held in an almost vertical position with the handle upwards. The fingers of the left hand are inserted into the vagina to reach the posterior surface of the head and the posterior blade is guided to its correct position up the hollow of the sacrum. If the diagnosis of the position has been correct, the handles will now fall together. Once a correct application is made, gentle traction and rotation is commenced.

In all cases of rotation—manual or forceps—and traction, the shape of the pelvis must be considered. In an anthropoid pelvis it would be a mistake to try to convert an O.P. into O.A. when the head is on the pelvic floor. In a platypelloid pelvis the head is best brought down in the transverse diameter till the pelvic floor is reached, while in an android pelvis it may be brought down only after rotation.

There is controversy over the place of Kielland's forceps in obstetrics. In low forceps deliveries the Simpson's forceps is ideal. In deep transverse arrest and engaged occipito-posterior position, manual rotation should succeed very often without using the forceps as a rotator, except in the neglected cases. In a high arrest and floating head, cæsarean section would be the better line of management. Kielland's

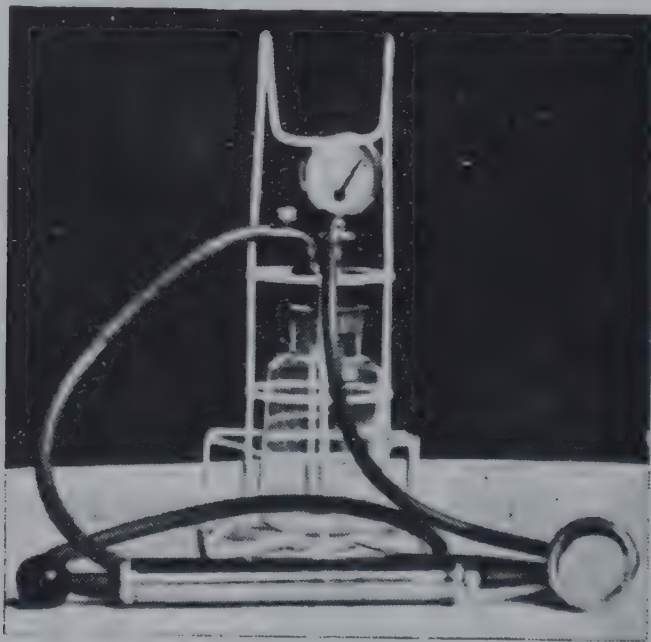


FIG. 149.—Vacuum Extractor.

forceps has its chief field of usefulness, when manual rotation fails in cases of transverse arrest. There are now many obstetricians who employ primarily Kielland's forceps in cases of deep transverse arrest. We would resort to it when manual rotation fails. Kielland's forceps has now a definite place in the specialist's armamentarium. However, it is the man behind the forceps more than the instrument itself that accomplishes the results.

The Vacuum Extractor (Ventouse). The vacuum extractor like the obstetric forceps is a method of getting hold of the foetal head while it is still in the birth canal. The obstetric forceps applied round the head gives force theoretically to the base of the skull, the extractor grips the scalp and it is almost true to say that the baby is pulled out by its hair.

In 1956 Malmstrom published a monograph in which he justified on mathematical grounds the forms of his vacuum extractor (shown in diagram above). He showed that on mechanical grounds the vacuum extractor is less dangerous than the forceps when used under given clinical conditions. Since then many obstetricians have started using the vacuum extractor.

The instrument consists of the vacuum bottle, gauge, rubber stopper and its three metal pipes, pump and pamphose. In addition, there are the extraction cups of different sizes—30, 40, 50 and 60 mm. diameter.

The extraction is performed under local infiltration anæsthesia. A suitable cup is selected and introduced by placing it edgewise in the vagina and pressing back strongly against the perineum. Under the control of two fingers, the cup is pushed towards the head and placed in direct contact with it at its most inferior and/or posterior parts. One must avoid placing the dome too anteriorly, as this would result in an increased risk of detachment due to obliquely diverted traction. The dome is held in place manually at the chosen site, while the assistant creates a vacuum of the order of two-tenths of an atmosphere. At the same time, taking advantage of the few minutes required for the formation of the artificial caput succedaneum within the cup, the operator carefully verifies with the forefinger moved round the edge of the cup, that it is directly applied to the head without the inclusion of maternal tissue, such as portions of the vaginal wall; and especially in multipara, portions of the cervix. After two or three minutes, the vacuum is increased to four-tenths of an atmosphere and after a further pause of the same interval, six-tenths of an atmosphere may be applied and eventually if necessary eight-tenths. It is important not to begin traction without pausing for the above time intervals. The quality of the 'chignon' or artificial caput which is the most important factor in good adhesion, depends essentially on the time allowed for its formation.

Traction should be intermittent and designed to coincide with the spontaneous uterine contractions. It must be exerted at right angles to the cup otherwise one edge will be lifted off and the vacuum broken. When the instrument is used during the first stage of labour a satisfactory outcome can be expected if the cervix becomes fully dilated within ten to fifteen minutes of starting the traction. As no general anæsthesia is employed, it is possible to co-ordinate traction with spontaneous uterine contractions. Traction also stimulates uterine contractions in a hypotonic uterus.

Obstetricians are in agreement regarding the use of the vacuum extractor when the head is below or at the level of the ischial spines.

There are some who advocate its use in occipito-posterior and transverse position of the vertex even with insufficient dilatation and also to stimulate uterine action. In many clinics the vacuum extractor has completely replaced the forceps using it for exactly the same indications. One of the advantages claimed is that the vacuum extractor can be used with a partially dilated cervix and a head in high midcavity when forceps cannot be employed. It can be safely used when the head is in mid or low cavity whatever the position of the occiput. However it should not be applied to the brow, the face or to the head of a premature infant.

One of the main advantages of the vacuum extractor is the minimum trauma it causes to the mother and the child. The artificial caput formed disappears within 24-48 hours. However when it has been used to deliver a head at high level intracranial injury is not uncommon. So also if it is applied over the cervix when it is incompletely dilated, avulsion of the cervix can occur. Its disadvantage is the time taken for delivery—a minimum of ten to fifteen minutes after application of the cup, when the head is at the outlet—so that when there is urgency to deliver the child because of distress, forceps would seem to be the better procedure.

VERSION AND DESTRUCTIVE OPERATIONS

Version. Version is a procedure in which the presentation of the fœtus is altered either by substituting one pole of a longitudinal presentation for the other or converting an oblique or transverse lie into a longitudinal presentation. It is designated respectively as cephalic or podalic version when the head or breech is made the presenting part. If the operation is carried out by external manœuvres only it is termed external version and if by intra-uterine manipulation it is designated Internal Version. If combined external and internal methods are employed—(one hand manipulating the fœtus through the abdominal wall and two or three fingers of the other hand through the cervix) it is termed Bipolar version—(Braxton-Hicks).

External cephalic version. The object of this procedure is to substitute a vertex for a less favourable presentation.

Indication. The common indication for external cephalic version is a breech or shoulder presentation diagnosed in the last weeks of pregnancy. Before resorting to this procedure it is necessary to make sure that (1) the abdominal wall is sufficiently thin to permit accurate palpation, (2) that the uterus is lax and contains sufficient liquor to help easy mobility of the fœtus, (3) the membranes have not ruptured and (4) the presenting part is not deeply engaged.

Majority of the malpresentations correct themselves by the 34th week of pregnancy. It is therefore advisable to correct by external version breech and shoulder presentation found persisting after 34 weeks. Correction could also be done prior to 34 weeks but more often the abnormal presentation recurs. Large baby, significant contraction of the pelvis, antepartum hæmorrhage, pre-eclampsia a classical cæsarean section scar are usually contra-indications for external version.

Technique. It is best to avoid anæsthesia. The patients abdomen is bared and the presentation and position of the fœtus are carefully ascertained if necessary even by radiography. Each hand then seizes one of the fœtal poles. The cephalic pole is then gently manipulated toward the pelvic inlet while the other is moved in the opposite direction. By a series of gentle stroking and pushing movements the head is brought over the pelvic brim. To keep it in position an

abdominal pad and binder may be applied. These patients should be re-examined a few days later when if the malpresentation has recurred version may be tried again. External version can be attempted early in labour also and if successful chances of recurrence of the malpresentation are very much reduced.

During the manipulations which should always be gentle, the foetal heart should be auscultated frequently. Any significant alterations in the foetal heart rate should be taken as a warning and it would be wise not to proceed with the version. As far as possible the attitude of flexion in the foetus must be maintained. Premature separation of the placenta and even rupture of the uterus are said to be complications resulting from this procedure. These are the result of injudicious manœuvres. Foetal mortality from external version is less than 1%.

Internal version. Internal version is usually or almost always podalic. By intra-uterine manipulations one or both feet of the foetus is caught and drawn out through the cervix.

In modern obstetrics there are very few indications for podalic version. They are (1) Transverse lie with the cervix fully dilated, membranes intact or recently ruptured, (2) Prolapse of the cord with the cervix fully dilated, (3) Second twin.

For performing internal version there must be plenty of liquor amnii in the uterus as it permits easy movements. Hence the membranes must be intact or very recently ruptured with enough liquor still left. It is best done when the cervix is fully dilated though it can be performed with $\frac{3}{5}$ dilatation. Under no circumstances should internal version be done when the liquor has drained away and the uterus tetanically contracted. If done under such circumstances rupture of the uterus is most likely.

Technique. The operation should be undertaken after carefully weighing all the factors involved and satisfying oneself that the conditions described above are present. The patient is prepared as for a major obstetric operation. After being anæsthetised, she is then brought to the edge of the bed and made to lie in the lithotomy position. When the patient is well under the anæsthetic, the operator separates the labia with one hand and passes the other gloved hand, formed into an obstetric cone, gradually into the vaginal cavity and then through the cervical canal into the uterus. The other hand is now placed on the sterilised towel over the abdominal wall to manipulate the foetal parts in the later stages of the operation. The hand in the uterus is guided past the presenting part, till it reaches a foetal knee. Slight pressure on the posterior aspect of the knee causes the leg to flex and drop down if it is extended. The hand is then passed along the skin

and the foot along with the heel is caught hold of. By gentle traction the foot is brought out of the cervical canal and the vagina. It is not essential to catch hold of both feet and bring them out simultaneously. If both can be caught hold of easily it may be done. Else it is enough to get out one foot. Usually gentle traction on one foot unless there are complications is sufficient to allow the breech along with the other foot to be born. At this stage it may be of help gently to manipulate the fœtus by the hand on the abdominal wall, so as to allow of the foot coming more easily through the cervical canal and to guide the head into the uterine fundus.



FIG. 150.—Internal podalic version. One hand in the uterus, the other steadying the fundus.

Controversy exists on which foot to bring down and which hand the operator should introduce. We think a good working rule is to introduce the hand which one is accustomed to work with. On theoretical considerations it is an advantage to bring the anterior foot down, as, if the posterior foot is brought down, the anterior buttock may hitch above the symphysis pubis, over-ride it, and prevent the descent of the fœtus.

It is of value, however, to emphasise the fact that whichever foot is brought down, it is necessary in the subsequent extraction of the fœtus, to see that the leg is so rotated as to bring the back of the fœtus anteriorly.

The subsequent stages of delivery of the fœtus have been referred to in the chapter on breech presentation. Once the position of the fœtus has been altered, the question whether immediate delivery is indicated or not must be decided by the condition of the fœtus and of the mother. But in all cases where immediate delivery is indicated, it is of importance to give sufficient time in the subsequent manipulations of extraction to allow the uterine ovoid to adjust itself to the altering position of the fœtal ovoid. In any case, it would be wiser not to proceed with extraction if the cervix is not fully dilated and retracted.

Prognosis. In properly selected cases the prognosis should be good, so far as the mother is concerned, as little or no damage need



FIG. 151.—Internal podalic version. A leg brought down.
Note the mode of grasping the foot.

be done to the maternal soft parts. There is, however, the increased risk of sepsis following an intra-uterine manipulation, as infection may be carried into the uterus from the lower genital tract. In cases where the operation is undertaken at a late stage of labour, there is a risk of rupture of the uterus.

So far as the fœtus is concerned, the prognosis depends upon the indication for the operation and the conditions under which extraction of the child has to be attempted. Asphyxia, intracranial injuries, fractures of various bones, may all add considerably to the risks of the fœtus if the operation is injudiciously performed.

The scope of internal version has become considerably narrowed within recent years as a result of modern surgical developments. Many complications once treated by version are now dealt with by cæsarean section with much greater safety to the mother and the child. It is true that, where efficient antenatal and intranatal care is available, internal version is confined mainly for the delivery of the second of twins and in certain cases of oblique lie. But situated as we are today, practising obstetricians in this country must be fully aware of the

indications and correct technique of internal version, while at the same time be cognizant of its dangers. The danger of rupture of the uterus during version cannot be emphasised too strongly, especially if done hours after the membranes have ruptured and all the liquor drained away.

Destructive Operations on the Foetus

Unfortunately it is sometimes necessary to perform destructive operations on the foetus with a view to diminish its bulk and so facilitate delivery and thereby save the mother. It is generally agreed that such operations should be done only on the dead child.

The destructive operations performed on the foetus are :—

(1) *Craniotomy*. It consists in perforating the skull, evacuating the cranial contents and extraction of the child. Some times for extraction the skull may have to be reduced in size further by comminuting it by means of a cranioclast or a cephalotribe. These two instruments are never employed in modern obstetrics.

(2) *Decapitation*. In this operation the head is separated from the trunk by cutting through the neck with a special decapitating hook, or a knife, or a pair of scissors.

(3) *Cleidotomy* consists in cutting through the clavicles, so as to reduce the bisacromial diameter when the child has too broad shoulders.

(4) *Evisceration*. The removal of the viscera from the abdominal or thoracic cavity after opening the abdominal or the thoracic wall.

(5) *Spondylotomy* is the term applied to cutting through of the spinal column and the division of the trunk of the foetus into two halves.

Craniotomy : Indications. Except in the presence of hydrocephalous craniotomy should not be performed on a living child. In the presence of a dead child craniotomy is indicated whenever delivery of the intact head is likely to be very difficult whether it be in a cephalic or breech presentation. Craniotomy should not be done even with a dead foetus in women with extreme degree of pelvic contraction where even after craniotomy vaginal delivery may not be possible.

Technique. The patient is given a general anæsthetic and put in the lithotomy position. After the preliminary toilette of the field of operation has been completed and the bladder has been emptied, the head is perforated. The first step in the stage of perforation is to fix

the presenting part, namely, the head. This can be done by one of two methods: (a) By an assistant applying suprapubic pressure, (b) by the application of forceps to the head. We prefer the latter method, as it steadies the head very efficiently and after perforation, in the majority of cases, permits the head to be delivered with ease by traction on the forceps. If this precaution of fixing the head is not taken, the chances are that the perforator may slip, as the head recedes under its pressure and thus cause serious damage to the maternal soft parts, in some cases perforating through the anterior vaginal wall and the bladder.

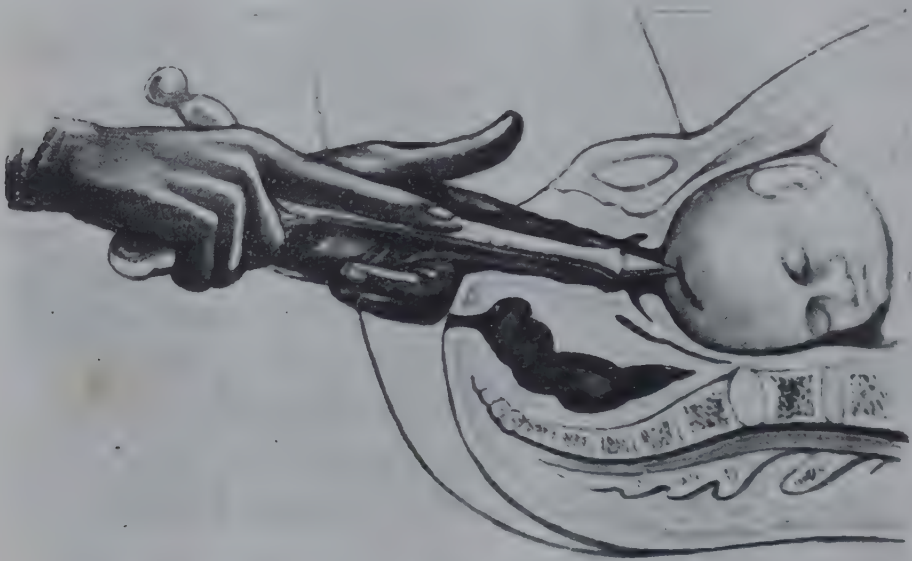


FIG. 152.—Craniotomy. Longitudinal slit made by the perforator.

The head having thus been fixed by the application of forceps, or suprapubic pressure the perforator is grasped in the right hand, two fingers of the left hand are passed into the vagina to locate the site of perforation, the perforator guided along the palmar aspect of the fingers and applied to the head, and the point fixed against the most prominent bony surface of the cranium; it is then pushed through the skull by a slight drilling movement, and as soon as the blades have pierced the skull, they are opened so as to cause a longitudinal slit. The perforator is then closed, turned at right angles, and reopened so that a crucial incision is made in the skull bone. Occasionally, when it is desired to make a large sized opening, it may be necessary to turn the perforator through the two oblique diameters of the opening and allow the blades to be opened in the same manner as has just been described. When the hole has been made in the bony skull, the perforator is passed into the brain substance which is then stirred up and the contents evacuated.

In cases of vertex presentation it is through a parietal bone, near one or other of the fontanelles. In cases of brow presentation, it is through the frontal bones; in a case of face presentation, through

the orbit or the roof of the mouth, and in an after-coming head it is through the occipital bone near the posterior Fontanelle.

After perforation if the forceps has been applied the fœtus can be delivered by traction with the forceps. Because of the collapse of the skull, sometimes the forceps might slip. In cases where the cervical dilatation is incomplete no attempt should be made to extract the fœtus.

The collapsed head may be expelled by spontaneous or oxytocin induced contractions instead of forceps traction. Occasionally it may be necessary to attach a heavy weighted tenaculum forceps to the collapsed skull to effect delivery.

Cranioclasm, cephalotripsy and basilectomy are other destructive operations which now belong to the realm of history and do not find a place in modern obstetrics.



FIG. 153.—Craniotomy. The perforator has been introduced into the vagina guided by the fingers and steadied against the head which is fixed in position by the preliminary application of forceps.

Decapitation. In this operation the head is severed from the trunk by cutting through the neck.

Indications. (1) In cases of neglected shoulder presentation with arm prolapsed, where the uterus is tonically contracted, Bandl's ring is present with signs of imminent rupture of the uterus and the child is dead.

(2) In some cases of locked twins, when the after-coming head of the first child is impacted by the head, shoulder, or body of the second child and the first child is dead.

(3) In double-headed monsters where decapitation of one head is necessary before the delivery of the monster can be effected.

Technique. The operation is best done under general anaesthesia. Several instruments may be used to effect decapitation. It may be done either :

(1) By the use of hooks, such as Braun's blunt decapitating hook, Ramsbottom's decapitating knife, Galabin's decapitating saw, or Jardine's decapitating hook with cutting knife ; or

(2) By the use of a long pair of sharp-edged, blunt-pointed scissors.

(3) Gigli's wire saw also can be employed.

In cases of neglected shoulder presentation, a sling is tied to the prolapsed arm and an assistant makes firm traction on it, so that the

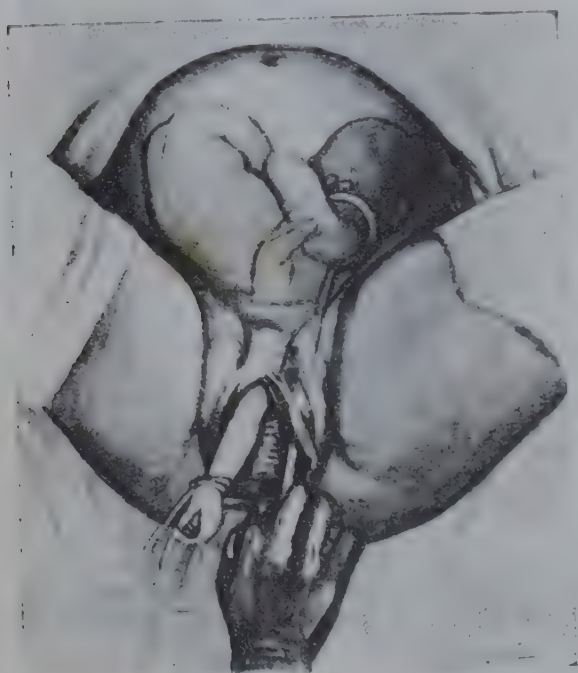


FIG. 154.—Decapitation. The hook *in situ*. Note that the knob is directed posteriorly.

shoulder is fixed in the pelvic cavity and the neck comes nearer the pelvic outlet. The operator passes two fingers of his left hand along the shoulder on to the groove of the neck, anteriorly. The decapitating hook is guided along the palmar aspect of the two fingers, and after it has reached the groove of the neck, it is gently rotated through a right angle, so that the knob of the hook is directed posteriorly. The hook then grips the neck firmly, and by rotating the instrument the tissues are cut through and the spinal column disarticulated and completely separated. Where

the separation of the soft parts cannot be easily effected by means of the blunt hook, a pair of scissors may be used to divide them. It is important to realise that no sudden force should be exerted in cutting through or twisting the soft parts with the hook, as otherwise it may slip and impinge upon some of the maternal soft parts and damage them. For the same reason the hook should never be passed with the blunt knob directed anteriorly, as, if by any chance the hook should slip, the knob may seriously damage the soft structures and even perforate the bladder.

Decapitation can be done with seissors, provided care is exercised in performing the operation so that the maternal soft parts or the

operator's fingers are not injured. The prolapsed arm is pulled down by an assistant ; the operator passes two fingers of his hand on to the neck ; then the scissors are passed along the palmar aspect of the fingers and applied to the neck, and gradually portion after portion is cut through, under the guidance of the fingers.

After decapitation has been effected traction should be exerted upon the prolapsed arm, when it will be found that the fœtal body is easily delivered.

After the delivery of the headless trunk, the head may be delivered by any of the following methods :—

(1) By fundal pressure.

(2) By passing two fingers into the mouth of the decapitated head and delivering it with fundal pressure and traction from below, as in the delivery of the after-coming head.

(3) Applying a crochet into the mouth of the fœtus, and by traction delivering it.

(4) The head may be fixed by a stout tenaculum forceps or by suprapubic pressure, and the obstetric forceps applied and delivery completed if necessary after perforation.

Cleidotomy. By this operation is meant the division of one or both the clavicles, with a view to diminish the bisacromial diameter of the dead fœtus, when there is difficulty with birth of the shoulders. It may be necessitated in cases of generally contracted pelvis, or pelvis contracted at the outlet, or it may be due to an excessively large child or an anencephalic monster. The head may have been delivered naturally, or after perforation. The further progress is impeded by the shoulders becoming wedged in the pelvic cavity. When this happens, the simple operation of cleidotomy may be performed by cutting through the clavicle with a pair of scissors passed under the protection of two fingers introduced into the vagina, along the anterior aspect of the shoulder. Generally, cleidotomy on one side is sufficient, but in extreme cases it may be necessitated on both sides. After cleidotomy, the child is delivered by traction on the head, or in some cases by traction on the head combined with traction exerted by a hook passed through the axilla of one side.

Occasionally, in the delivery of a large macerated fœtus, particularly for instance, in a diabetic patient, the obstruction by the shoulders is very pronounced. Any attempt, after cleidotomy, at traction on the head may lead to laceration of the macerated muscles of the neck and even separation of the head. Under such circumstances, it may be necessary carefully to pass the hand into the vagina to one side, flex

one fore-arm at the elbow, grasp the wrist, and deliver the limb by gently pulling it out. There is then a better hold for traction, and the wedge having been broken up, the child can usually be delivered; in some cases it is necessary to bring down both arms and then introduce a crochet into the chest of the child, and hook it against the ribs before finally extracting the macerated fœtus.

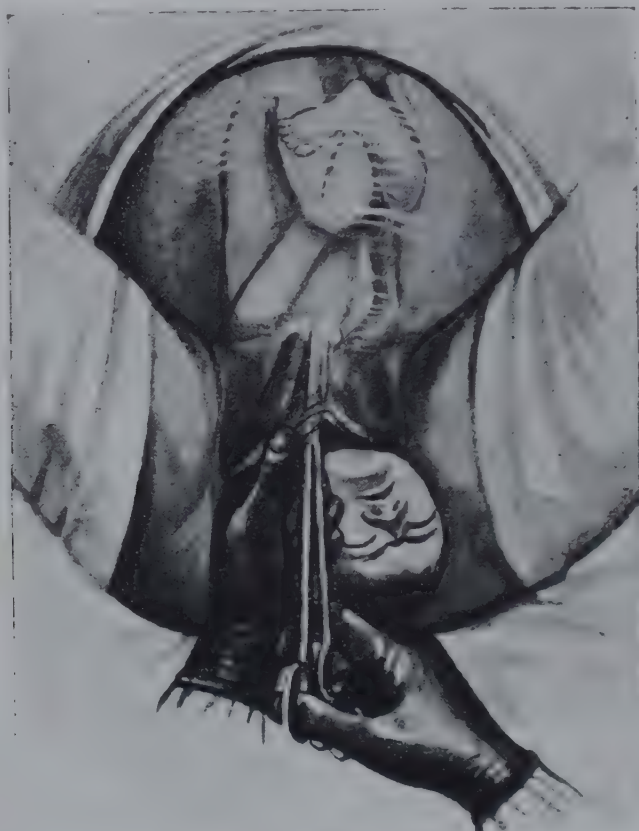


FIG. 155.—Cleidotomy.

Evisceration. By this is meant the opening of the thorax or abdomen, or both, and the removal of their contents.

Indications. (1) In cases of neglected shoulder presentation, where the arm is not prolapsed and the neck is not within reach for decapitation to be performed, evisceration is necessary before spondylotomy can be thought of.

(2) Where undue enlargement of the thorax or abdomen is present, due to tumours, hydrothorax, congenital anomalies, fœtal ascites, cystic kidney or distended bladder.

Technique. The operation can be done with the perforator or with a straight or curved pair of scissors. Whatever instrument is used, the maternal parts should be carefully protected from injury, and the instruments always guided along the fingers of the operator passed into the vagina. When perforating through the thorax it is necessary

to make a fairly big opening which can best be done by cutting away several segments of the ribs so as to make evisceration possible.

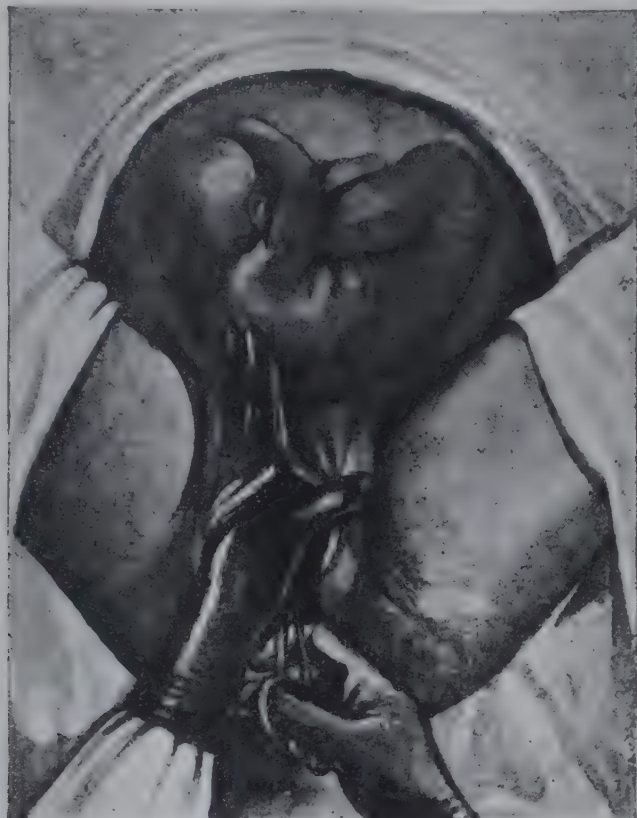


Fig. 156.—Embryotomy in a case of shoulder presentation.

Spondylotomy. In this operation the spinal column of the fœtus is divided and the trunk is cut into two halves.

This is done in cases of neglected shoulder presentations, where the neck is too high for decapitation to be performed and where the arm is not prolapsed. In such cases the uterus being in a state of threatening rupture and the child already dead, version is absolutely contra-indicated.

Mode of Operation. The operator passes his fingers against the spinal column of the fœtus, and first cuts through the soft structures of the abdominal wall, with a view to evisceration of its contents. The spinal column in the lumbar region can then be hooked round by the finger, and with a powerful pair of scissors cut through into two halves. Further separation of any of the soft structures can be easily done, when the body has been completely divided into two halves, each half being separately delivered by traction. The first half to be delivered should be the lower half of the fœtal trunk, and this can be done by applying a strong pair of tenaculum forceps on to the divided end of the spinal column and pulling, so that the pelvis and lower extremities are extracted. Later, the upper half, can be delivered by pulling upon the divided spinal column and extracting the trunk

in a manner similar to that adopted in the delivery of a breech presentation. If any further difficulty arises in the delivery, such destructive operations as cleidotomy or perforation may also have to be performed.



FIG. 157.—Spondylotomy.

Delivery of the distal half of the body after spondylotomy.

Whenever these destructive operations are performed it is best to be prepared for treatment of shock and sometimes post-partum hæmorrhage. Puerperal infection may follow. In all cases it is advisable to explore the uterine cavity to rule out a rupture.

CÆSAREAN SECTION

CÆSAREAN section is one of the oldest obstetric operations. Its history and career are to the obstetrician still thrilling. We refer our readers to Young's *History of Cæsarean Section* as we cannot do justice to it in a text-book on 'Clinical Obstetrics'.

Cæsarean section is the removal of a child through an incision in the abdominal wall and uterus but from an intact uterus. The term should not be applied to the removal of a child from the abdomen after rupture of the uterus with or without protrusion of the whole or part of the child into the peritoneal cavity nor to an operation for abdominal pregnancy.

Incidence. The incidence of cæsarean section varies with geographic location and from hospital to hospital; but in general about 4 to 5 per cent of pregnancies are terminated by abdominal delivery. In the Government Maternity Hospital, Madras, during a eleven-year period among 150,662 deliveries, there were 3074 cases of cæsarean section giving an incidence of 2.1%.

Indications. The safety afforded to surgery with the advent of chemotherapy, antibiotics, blood transfusion and improved anæsthesia has extended the use of cæsarean section with the result that one finds the tendency to resort to cæsarean section on flimsy indications. This is a tendency which should be guarded against.

There are many indications for cæsarean section—some of them are unquestionable but quite a large number fall in the group 'probably necessary'.

(1) *Cephalopelvic disproportion and contracted pelvis.* In any large series of cæsarean section cephalopelvic disproportion and contracted pelvis form the largest number—(60%-70%). When the pelvis is so contracted that, even after mutilation, a dead child cannot be delivered *per vaginum*, it is said to be an absolute indication. Such absolute indications are seldom met with in present day obstetrics. When the pelvis is contracted or cephalopelvic disproportion is such that delivery of a live child *per vaginum* is not possible, elective cæsarean section is the treatment of choice. In borderline pelvis and minor degrees of disproportion trial labour is the line of management. When trial labour fails, cæsarean section becomes necessary to deliver a live child.

In spite of the safety rendered to cæsarean section under modern conditions, maternal mortality and morbidity will increase with the duration of labour, especially after rupture of the membranes. Hence, for obtaining the best results, careful selection of cases must be made and undue prolongation of trial labour avoided. Cæsarean section should not be the last resort of the obstetrician after other methods of delivery have been attempted and have failed.

(2) *Dystocia due to soft parts.* Occasionally, obstruction to labour may be caused by ovarian or uterine tumours complicating pregnancy and may necessitate cæsarean section. Partial atresia of the vagina and cervix and cicatrization in the lower genital tract may occasionally necessitate cæsarean section.

(3) *Inadequate uterine forces.* We are still in the dark regarding the causation of the onset of labour and factors influencing proper uterine action. Though much has been achieved, a great deal more remains to be done. Uterine inertia and inco-ordinate uterine action of all varieties fall in this category. When uterine action becomes abnormal or fails, labour becomes prolonged and if permitted to continue indefinitely the prognosis for the mother and the child gets worse. The risk to the fœtus is apparent if labour is not completed within 24-48 hours after rupture of the membranes. Usually, sedatives and, in hypotonic inertia, oxytocin drip are given a trial. When these fail, and labour has lasted longer than 24 hours, there is a definite tendency to resort to cæsarean section. In fact, compared to previous years, there is a greater incidence of cæsarean section in this group.

(4) *Antepartum hæmorrhage.* The safety afforded by cæsarean section under modern conditions is reflected very largely in the great increase in the number of cæsarean sections done for placenta prævia and to a much smaller extent for premature separation. It is almost always a rule to do a cæsarean section in all cases of Types III and IV placenta prævia, while in Types I and II it is often resorted to if the fœtus is 38 weeks and over, is alive and if bleeding is not controlled by artificial rupture of the membranes and oxytocin drip. In premature separation, cæsarean section is limited to certain types of cases. Where in spite of artificial rupture and oxytocin drip, labour has not been established within 6-8 hours and the patient's condition is not improving satisfactorily in spite of blood transfusion, cæsarean section should be considered.

(5) *Pre-eclamptic toxæmia.* In fulminating pre-eclamptic toxæmia many resort to cæsarean section in the interests of the mother. In the less severe cases, in whom it is decided to terminate pregnancy and where vaginal examination reveals that response to induction will not

be satisfactory, there has been an increasing tendency to resort to cæsarean section with marked improvement in fœtal salvage rate. This increase in salvage rate has been rendered possible due to the very great improvements in the care of premature infants.

(6) *Eclampsia*. For a long time and even today eclampsia is considered a contra-indication for cæsarean section. From our personal experience we are convinced that in properly selected cases cæsarean section has a definite place in its management. In patients with closed uneffaced cervices, when planned conservative management has failed to control the convulsion within eight to ten hours of the start of treatment, cæsarean section would be indicated.

(7) *Fœtal distress and prolapse of the cord*. There has been of late a large increase in the incidence of cæsarean section for fœtal distress. Whatever be the cause of distress, if conditions suitable for easy vaginal delivery are not present when the distress is diagnosed, the tendency is now to resort to cæsarean section in the interests of the child.

When the cord prolapses with an imperfectly dilated cervix and the fœtus is in good condition, the best method of saving the fœtus is by cæsarean section. Any other method is associated with a high fœtal mortality.

(8) *Malpresentation*. It is difficult to decide whether malpresentation is primarily an indication for cæsarean section. Very often these malpresentations are associated with contraction of the pelvis or other factors which by themselves may not be a primary indication for cæsarean section but in combination indicate cæsarean section. A persistent shoulder presentation in a primigravida at term is mostly dealt with by cæsarean section. When the arm prolapses with only a partially dilated cervix, better fœtal salvage rate is obtained by resorting to cæsarean section. Breech presentation by itself is not an indication for cæsarean section, except when the baby is unduly large. It has been shown that fœtal mortality for breech delivery rises considerably when the baby weighs over eight pounds and hence many recommend cæsarean section when the baby is assessed to be large. Persistent mento-posterior position may at times necessitate cæsarean section, as also some cases of deep transverse arrest. These have been discussed in detail in the relevant chapters.

(9) *Maternal diseases*. Under modern conditions the pregnant diabetic woman can safely withstand the shock of both surgery and anæsthesia. In diabetes cæsarean section is widely employed, unless the obstetric history, the size of the baby and the state of the cervix make an easy vaginal delivery almost a certainty. It should be used in all cases in which the supervention of toxæmia makes immediate

delivery highly desirable and in patients in whom the presence of a large baby is suspected.

(10) *Heart disease in pregnancy.* Every attempt must be made to avoid cæsarean section in these cases. Where however there are, in addition, complications like disproportion it would be wiser to do a cæsarean section. A cardiac patient is not a suitable candidate for trial labour. Coarctation of the aorta is considered by some as an indication for cæsarean.

(11) *Bad obstetric history and habitual intra-uterine death of the foetus.* Patients who give a history of repeated difficult deliveries and perinatal deaths of their babies in whom the foetal loss is not due to toxæmia or other like complications may have to be delivered by elective cæsarean section in a subsequent pregnancy, as also patients who give a history of habitual intra-uterine death about term.

(12) *Elderly primigravida.* It is a moot question whether pregnancy in the elderly primigravida—pregnancy occurring for the first time after the age of 35—is by itself an indication for cæsarean section. There are many who resort to elective cæsarean section on this indication alone. There is no doubt that these patients are heavily weighted in favour of cæsarean section even in the absence of any complications. We are not averse for a trial of vaginal delivery and resort to section when at onset of labour the head is unengaged or there is a malpresentation or any other maternal complication like toxæmia. An elderly primigravida is not a suitable candidate for 'trial labour'.

In addition to these, foetal monstrosities like double monsters may necessitate cæsarean section. While one single factor alone may not indicate cæsarean section, often a combination of minor adverse factors necessitates a cæsarean section in the interests of the child. Adequate prenatal care, improvements in operative technique and antisepsis, improved anæsthesia, the availability of blood for transfusion and antibiotics have made it possible to reduce the foetal and maternal mortality considerably. The unwillingness to risk the mother or baby by difficult obstetric manœuvres *per vaginam* has also contributed to this reduction. At times this principle has been applied a little too enthusiastically. It is very necessary to estimate the possibility of real difficulty as accurately as possible with all the scientific methods at our disposal before resorting to cæsarean section. Else one would be resorting to cæsarean section on the flimsiest of indications which must be avoided. That would be an obvious misuse of the safety of cæsarean section under modern conditions.

Time for Operation. This question arises only when cæsarean section is to be done as an elective procedure. If the patient is certain

of the date of the last menstrual period and the obstetrician convinced that the foetus is full term, it is best to do the operation as a planned surgical procedure at or soon after the due date. Under such conditions, the best results are obtainable. If there is doubt as to the maturity of the foetus, it is best to wait for the onset of labour in the interests of the child. If section is done within four to six hours of onset of pains there is no appreciable difference in maternal and foetal mortality rates. The only inconvenience is that the operation has to be performed as an emergency.

Technique of Operation. *Classical Cæsarean section.* After the preliminary preparations (as for any abdominal operation), the patient is brought to the table anæsthetised. The choice of the anæsthetic is a matter for the anæsthetist to decide in consultation with the obstetrician. General, epidural local or spinal anæsthesia may be used. The problem of anæsthesia in cæsarean section is discussed in greater detail in the section on anæsthesia and analgesia.

An incision is made in the middle line of the abdominal wall about six inches in length, the greater part of the incision being below the umbilicus. Having opened into the abdominal cavity, the uterus is found directly underneath the incision. Eventration of the gravid uterus is not necessary in the classical or in the lower segment cæsarean section. The uterus may be lying more to one side than the other, generally being pushed to the right side. The assistant must bring it into the median line so that the incision in the uterus may be exactly in the median line of its anterior wall. The sides of the uterus are now packed off with sterilised gauze, so that when the uterus is opened into, little of the material may gravitate into the abdominal cavity. With the uterus *in situ*, an incision of from 5 to 6 inches is made in the median line. The abdominal wall can be retracted to allow of this incision being made more easily and deliberately.



FIG. 158.—Abdominal cæsarean section : classical. The abdomen has been opened and the line of uterine incision shown.

Just before incising the uterus, it is desirable to give 0.25 mg. of Methergine intravenously to favour uterine contraction and retraction. As soon as the uterine cavity has been opened into, the operator ruptures the membranes, passes his hand inside, gets a firm hold of the child

by one foot and extracts it. If the uterine incision is not sufficiently long, difficulty may be experienced in the delivery of the after-coming head. It is better under these circumstances, to pass two fingers into the uterine opening and enlarge the incision by means of scissors guided by the fingers in the uterine cavity. As soon as the child has been delivered, the cord is clamped in two places and cut between, and the child handed over to the third assistant. Immediately after the delivery of the child, the uterus is brought out of the abdominal cavity and anteflexed over the symphysis pubis.

Occasionally, the placenta may be in front and severe hæmorrhage may be encountered. The operator should not be unnerved by this hæmorrhage, but should boldly pass his hand into the uterine cavity, going to one side of the placenta or through the incised organ, rupture the membranes, and then seize the child by the foot and deliver it. As soon as the child is delivered, the hæmorrhage generally stops.



FIG. 159.—Delivery of the child through the uterine incision.

After allowing the uterus to rest for some time to contract properly, the placenta should be expressed by squeezing the fundus and pushing the placenta out through the uterine incision. If this is not possible, the placenta is gently separated by means of fingers and removed with care, so that the membranes are also removed entire. In patients who are not in labour at this stage it is desirable to pass a finger through the internal os, to dilate the cervical canal so that free drainage of lochia may be favoured in the puerperium. If the hæmorrhage does not stop, the uterus is squeezed by wrapping it with sterilised hot towels rinsed dry. In the large majority of cases, the

hæmorrhage stops promptly. Where the bleeding continues owing to the laxity of the uterine musculature, an injection of 10 units of oxytocin or 0.25 mgm. of methergine or ergometrine should be given directly into the uterine muscle. This helps to promote efficient contraction and retraction. The suturing of the uterine incision helps to control the hæmorrhage and should be begun at once.

Method of Suturing. Whatever be the method of suturing adopted, it is exceedingly important that the endometrium of the uterus is not included in the suture. The muscular wall may be closed in two or three layers. Interrupted sutures only should be employed. Between each suture there should not be more than $1/8$ " gap. The first layer includes three-fourth of the thickness of the muscle and should not include the endometrium. The second layer takes in the rest and this is covered by suturing over it the visceral peritoneum. Chromicised catgut is now the preferred suture material.

After the uterus has been properly sutured, any blood-clots collected inside expressed through the cervical canal, it is returned into the abdominal cavity. The peritoneal cavity is cleared of any blood-clots, and the abdomen is closed in layers. After applying sterile dressings to the wound, the vaginal should be cleared of all blood-clots and a sterile pad applied.

Difficulties and Complications. Difficulties and complications may arise in the course of a cæsarean section. These are :—

(1) *Acute delivery.* The head may be engaged in the brim of the pelvis and difficulty experienced in extracting it. The uterine incision may have to be extended towards the symphysis pubis, and with traction on the legs and gentle manipulation, if necessary by passing a finger into the mouth of the fœtus, the head is delivered.

(2) *Placenta.* The difficulty experienced when the placenta is in front and the mode of delivery of the child to be adopted in such cases had already been referred to.

(3) *Hæmorrhage.* Bleeding is controlled by suture of the incision, by injection of oxytocics into the uterine musculature and by hot compresses applied over the uterus. Blood loss should be rapidly replaced. If still bleeding cannot be controlled due to atonicity as sometimes happens in a grand multi para hysterectomy would be indicated.

(4) *Infection.* If infection is suspected classical section should be avoided. If not peritonitis will develop.

(5) Post-operative adhesions and intestinal obstruction as late complication are more common with classical cæsarean section.

(6) *Late complications—Uteroparietal fistula.* This is a late sequela and an uncommon one. It occurs many months after the classical operation as a result of a fistulous tract existing between the uterine cavity and the abdominal wall incision. The fistulous opening on the uterus is situated anywhere along the line of the classical incision and the uterus is adherent to the anterior abdominal wall. Through the opening in the abdominal wall at the time of the menstru-

ation, menstrual fluid escapes which stops with the cessation of the period. The diagnosis is not difficult and radiography after injection of radio-opaque material through the cervix or through the abdominal wall opening will reveal the true nature of the fistula. Treatment is excision of the fistulous tract and closing the openings.

(7) *Scar endometriosis.* This is another uncommon late complication setting in, many months after the classical operation. The history is characteristic: the patient complains of a nodular swelling in the region of the scar which increases in size at the time of the periods and subsides after it. At times there is associated pain. After a few cycles the nodule may rupture leaving a raw area through which dark blood escapes at the time of the periods. It may communicate with the uterine cavity when it is identical with a uteroparietal fistula. The treatment is excision of the scar.

(8) Rupture of the scar in a subsequent pregnancy.

During the puerperium, the usual treatment adopted for cases of laparotomy should be observed. The chief complications are: peritonitis, and intestinal obstruction. Intestinal Paralytic ileus is a troublesome complication, and is perhaps more frequent after classical *cæsarean* section. Distension, should be treated by rest, morphia, intravenous glucose saline drip and Ryle's tube aspiration of the stomach. Acute dilatation of the stomach may some times occur and requires gastric lavage.

Lower Segment *Cæsarean* Section. In modern obstetrics *cæsarean* section is taken to mean 'Lower segment *cæsarean* section.' Because of its many advantages over the classical section, the latter is avoided and is performed only rarely. The lower segment operation can be safely performed after trial labour and when infection is suspected—the two conditions wherein the classical operation is risky. The healing of the lower segment incision is also more sound because better approximation of the edges of the wound by suture is possible and the lower segment being comparatively quiescent in the puerperium allows better healing. Hence rupture in a subsequent pregnancy and labour is very much less frequent. The convalescence also is much smoother than after the classical operation. The only disadvantage is that the operation is a little more difficult than classical operation.

Technique. The patient is prepared as for the classical operation; the bladder is emptied by a catheter and the patient placed in a moderate Trendelenburg position. The abdomen is opened in the mid-line by a sub-umbilical incision which should extend to as near the symphysis pubis as possible. It is wise to carry the

incision as low as possible, as then, the whole of the lower uterine segment can be properly exposed by retraction of the abdominal walls.

The uterus is then exposed, and the surrounding area packed off with gauze wrung out in saline. The peritoneum on the anterior wall of the uterus, just above its reflection over the bladder, is then caught hold of loosely by a dissecting forceps, and a transverse incision made over the peritoneal investment at this level, extending from one side of the anterior uterine surface to the other. The upper flap of the peritoneum thus divided is then separated by means of the finger covered with a piece of gauze and then lifted up whereas the peritoneum with the bladder in front is separated from the uterine wall and pushed as



FIG. 160.—Lower segment cæsarean : abdominal incision.

low down as possible. The peritoneum is reflected upwards as far as possible, up to the level of its firm attachment to the uterine wall. By thus reflecting the two flaps of the peritoneum above and below, the entire lower uterine segment and portion of the upper part of the cervix become exposed. At this stage the uterus may be opened into, either by a curvilinear transverse incision or a vertical incision. We almost always employ the curvilinear transverse incision and rarely the vertical. A transverse incision about one inch long is made in the musculature. It is deepened till the uterine cavity is entered. With the two index fingers introduced at either ends of this incision, it is extended on either side, by stretching with the fingers in opposite directions. Occasionally, the vertical incision, if it is not sufficiently long for the delivery of the fœtal head, may extend towards the bladder during the process of delivery of the fœtus, and thus give rise to troublesome hæmorrhage. After opening into the uterus the palm of the hand may be used to lever the head out, while the assistant helps with fundal pressure. Occasionally, one blade of the forceps may be used for this purpose. The forceps may be applied and the head extracted through the uterine incision. We think that this step is unnecessary. The head can also be seized by Willett's forceps applied to the scalp and gently pulled through the opening. Care should be taken before delivery of the head, to see that the incision is sufficiently long to allow the head to be

delivered without tearing the lateral ends of the wound in an irregular manner. Once the head of the child has been delivered, the rest of

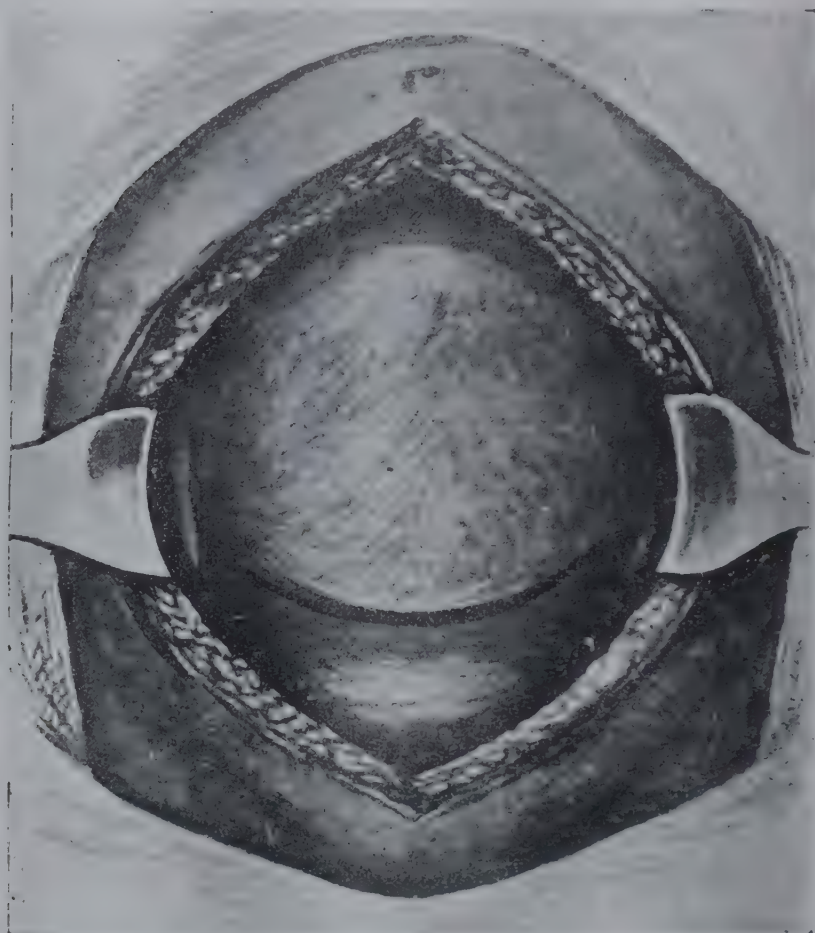


FIG. 161.—Lower segment cæsarean : uterus exposed and a transverse curved incision made just above the bladder.

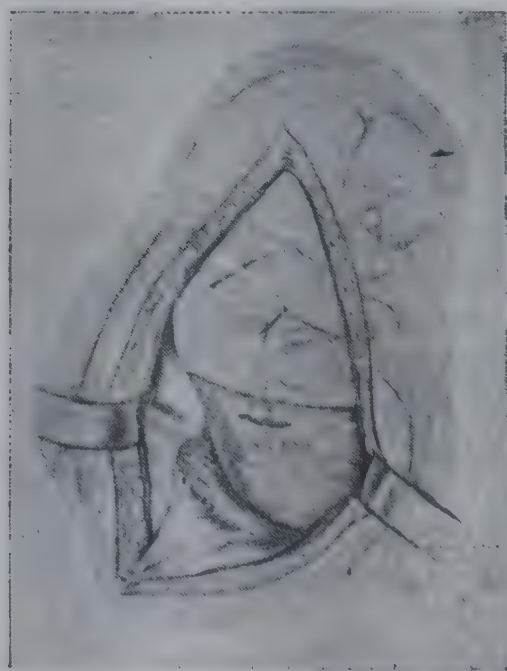


FIG. 162.—Lower segment cæsarean : small incision in lower segment.

the body follows with ease. Just prior to incising the uterus, 0.25 mgm. of methergine is given intravenously. Most often it will be found that

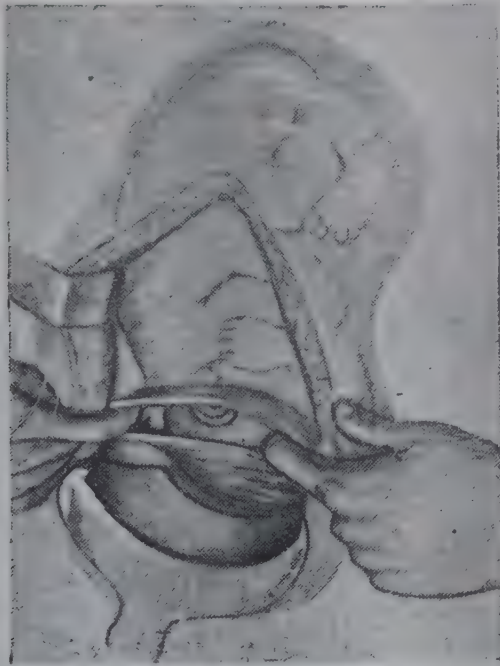


FIG. 163.—Lower segment cæsarean: enlarging incision by stretching with the fingers.



FIG. 164.—Lower segment cæsarean. Delivery of the child through the incised opening.

the placenta has separated by the time the child is extracted and the third stage can be completed easily by pulling on the cord. The blood loss is less with this technique. If it has not separated by the time

delivery is completed, the placenta should be manually removed. Once the placenta has been removed and the uterus well contracted, the incision is closed by continuous or interrupted catgut sutures taking care not to include the endometrium in the sutures. A second layer of continuous catgut sutures is employed to cover the first one and the peritoneal flaps are then brought into apposition by continuous catgut suture. Extra care should be taken in suturing the incision in the lower uterine segment to obtain close and good approximation of the cut edges. The abdomen is then closed in the usual manner.

Some common difficulties and complications encountered at operation. (1) The commonest difficulty encountered is in deliver-

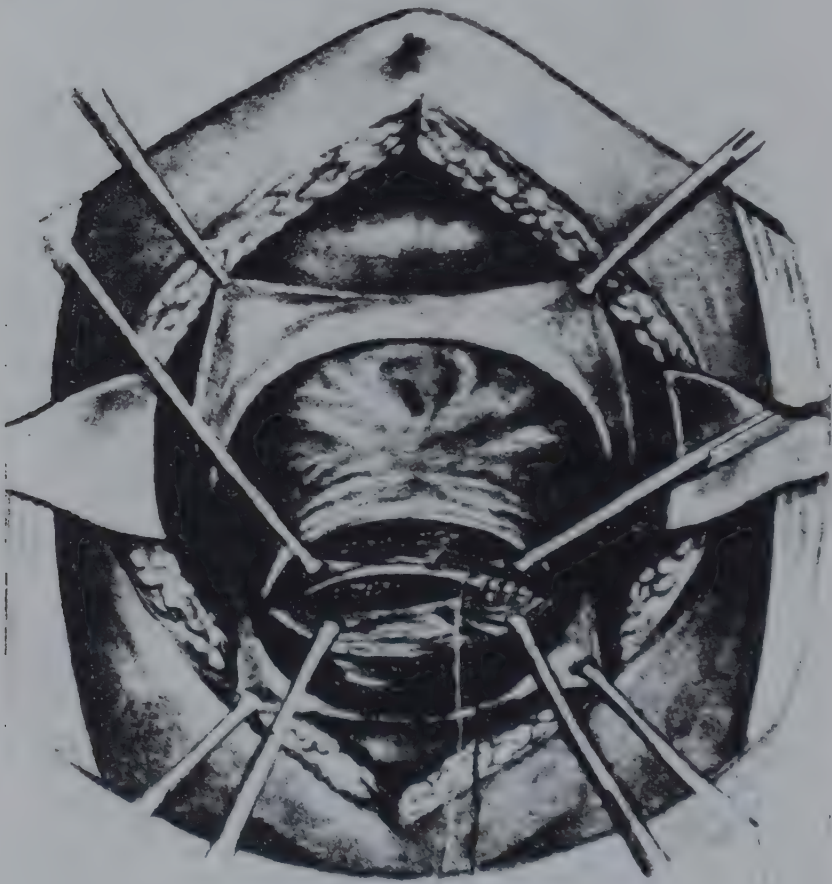


FIG. 165.—Lower segment caesarean. The method of suturing the lower segment incision in layers.

ing the head through the incision in the lower segment. The delivery of the head may give rise to difficulty when the head is floating and is therefore above the incision in the lower segment. This difficulty is exaggerated if the patient is in Trendelenburg position. Greater difficulty may be experienced when the lower segment caesarean section is undertaken late in labour for a deep transverse arrest of the head in the cavity. In cases with floating head, the head can, by gentle mani-

pulation, be made to engage in the incision fixed in that position by the left hand or by the assistant and with the right hand passed behind the head through the incision it can be levered out. Gentle fundal pressure will help. Some proceed to deliver by internal podalic version and extraction through the incision under these circumstances. We have also done it in select cases on occasions and are convinced of its usefulness and safety when there is plenty of liquor in the uterus. When the head is deeply wedged in the cavity, we have seldom failed

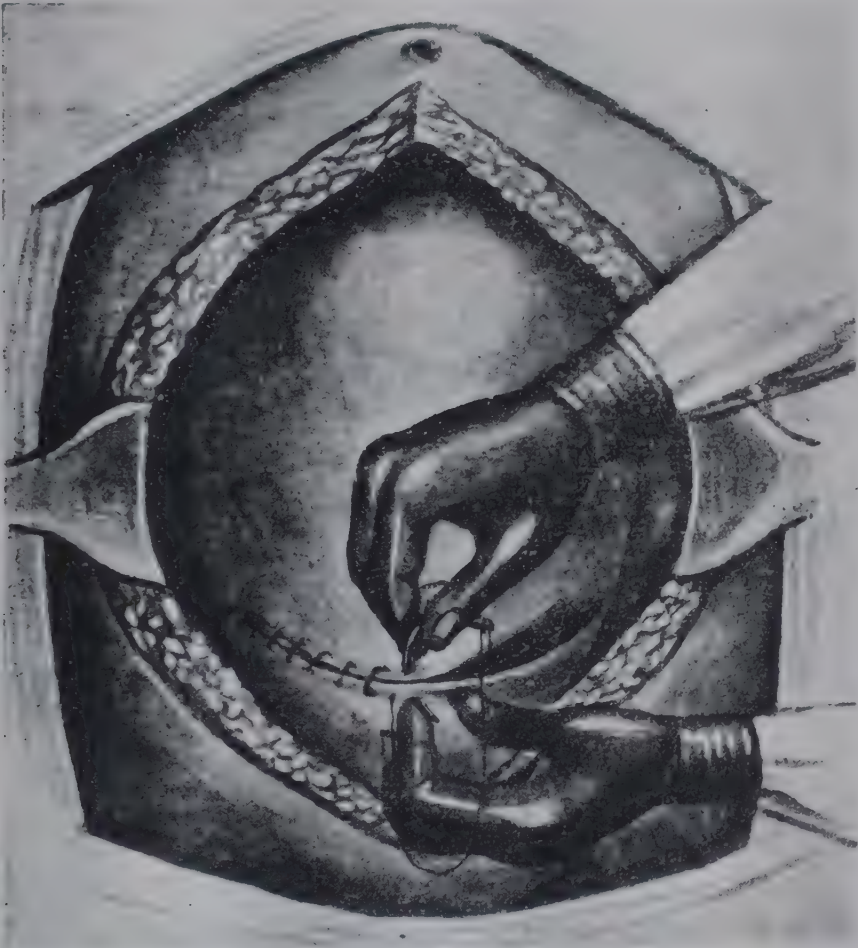


FIG. 166.—Lower segment cæsarean. Suturing up of the peritoneal coat over the lower segment.

to deliver it by the usual technique—passing the hand through the incision, getting the hand well behind the head and levering it out. Trendelenburg position is of real help in these cases. It has been suggested that an assistant could push the head up from below through the vagina. We have rarely adopted this but we think it could be useful when the ordinary methods fail.

(2) Especially in impacted shoulder presentation and arm prolapse, lower segment cæsarean section may offer considerable difficulty in delivering the child. It is in these delayed cases also that the value of this operation lies as it is more safe to the mother. With the lower uterine segment thinned out, delivery of the child by version may

give rise to extension of the incision laterally. Often it may be difficult to get at the foot. Under these circumstances, one may have to put a vertical incision extending into the upper segment (inverted T incision) when such difficulty is experienced. Alternately, one performs a classical cæsarean section which if possible should be avoided.

(3) When incising the uterus, especially in delayed cases with thin lower segment, the baby may be injured or as in some cases of posterior placenta prævia the cord may present in the incision and be cut. When the lower segment is thin, the small transverse incision should be made in such a way as not to enter the uterine cavity. By teasing the exposed tissue with a forceps or even the finger, the uterine cavity can be opened into and then by stretching with the fingers the incision can be extended. At times some large blood vessels are seen coursing over the lower segment. These can be ligatured and cut before proceeding with the operation as otherwise profuse bleeding may result.

(4) The incision may extend laterally and involve the uterine artery or its branches in the process of extracting the head. This seldom happens when the incision is enlarged by stretching with the fingers. If the head is too large for the incision or the lower segment itself is not broad enough for the size of the head, lateral extension of the incision may occur. It is necessary to avoid this and for this the incision must be made as long as possible and the head delivered slowly during which the lateral angles of the incision must be watched. If the lower segment is not wide enough a vertical incision may be employed.

(5) When a vertical incision is employed it may extend down and involve the bladder.

(6) At times, while suturing, the bladder may be included in the stitches and give rise to late complications. A rare complication is wherein, as a result of fistulous communication between the bladder and the lower uterine segment, the menstrual blood enters the bladder and is passed in the urine. We have seen two such cases—both resulting from a previous lower segment cæsarean section.

(7) When non-absorbable sutures are used, like silk or silk-worm gut, and the bladder is inadvertently included in the suture, these sutures work their way into the bladder and may be passed by the patient *per urethrum*. We had an instance where a calculus was formed in the bladder with the silk suture as a nucleus. (In this case it was a classical cæsarean section.)

The post-operative convalescence after a lower segment operation is far smoother than after a classical. Post-operative adhesions and intestinal obstruction later in life are also less common.

One of the greatest dangers of a classical cæsarean section is the rupture of the scar in a subsequent pregnancy and labour. The reason for such a rupture is said to be imperfect healing resulting in a weak scar. The weakness is enhanced if there has been infection. The incidence of scar rupture is far less after a lower segment section as the healing is better and scar stronger. Hence, with all these favourable factors, in modern obstetrics cæsarean section is almost always a lower segment operation, except under exceptional circumstances when classical is done.

Radical Cæsarean Section. *Cæsarean hysterectomy.* In this operation, after extraction of the fœtus through the abdominal route, the uterus is removed. This may be done either by total hysterectomy or by supravaginal or subtotal hysterectomy.

Indications. The removal of the uterus in a woman of the child-bearing period should not be lightly undertaken, but occasionally it is necessary to perform an operation of this nature for the safety of the mother. In modern obstetrics the indications for hysterectomy at the time of cæsarean section are very limited. They are :

(1) *Multiple fibroids complicating pregnancy and labour.* During pregnancy there is rarely any indication for laparotomy when fibroids complicate pregnancy. When they obstruct labour and cæsarean section is adopted as the mode of delivery in a multigravida with multiple fibroids, which make myomectomy hazardous, hysterectomy would be indicated.

(2) *Rupture of the uterus.* Rupture of the uterus, whether it is spontaneous, traumatic or due to rupture of a previous cæsarean section scar, is almost always treated by hysterectomy, except at times in a young patient when suture of the rent and sterilisation is undertaken.

(3) *Premature separation of the placenta.* A couvelaire uterus, until a few years ago, was almost always the indication for hysterectomy at the time of cæsarean section on the understanding that such a uterus is incapable of proper contraction and retraction and hence will result in severe post-partum hæmorrhage. It is now realised that in most of these cases the post-partum hæmorrhage is due to coagulation failure and hence hysterectomy is unnecessary. However, at times atonic post-partum hæmorrhage may complicate the picture and render hysterectomy necessary. The incidence of hysterectomy for this condition has fallen considerably.

(4) Especially in the multigravida, when cæsarean section is done, severe atonic post-partum hæmorrhage may occur. The uterus may

be very flabby in spite of oxytocics and hysterectomy may be necessary to save the mother from hæmorrhage.

(5) When there is frank infection and the patient is in the older age group with sufficient number of children, hysterectomy would be indicated at the time of cæsarean section.

(6) In cases of placenta accreta.

(7) Radical hysterectomy with lymphadenectomy may be resorted to in cases of early cancer of the cervix complicating pregnancy.

Repeat Cæsarean Section. Where a cæsarean section has been done for a recurring indication like contracted pelvis, it will be necessary to repeat the cæsarean section at subsequent deliveries. There are many who believe in the widely prevalent maxim, 'once a cæsarean section, always a cæsarean section'. Irrespective of the previous indication, those who believe in this dictum, repeat the section at all subsequent deliveries. Cæsarean section need not be repeated as a routine in a subsequent pregnancy, especially when this was done for a non-recurring indication. Careful selection of cases and close observation in labour will permit a large number to be delivered safely *per vaginam* provided it is undertaken in well equipped hospitals.

The number of times a cæsarean section can be safely performed on a patient depends upon several factors; cases have been recorded where cæsarean section has been performed even a dozen times. We have performed this operation as many as four times on the same patient but we are inclined to the view that cæsarean section repeated so frequently puts a heavy mental and physical strain on the patient; if the previous children are alive, we prefer to sterilise a patient at the third section. To a certain extent the maternal mortality increases with the number of cæsarean sections performed on the same patient.

Sterilisation at Cæsarean Section. This procedure should not be lightly undertaken. In most cases it is undesirable to sterilise a woman after one pregnancy. The uncertainties of life connected with the new-born child and the problems created by the psychology of the 'only child' must be a sufficient warning to the obstetrician not to yield easily to the patient's request to sterilise her after her first child is born. With modern technique the dangers of a repeat cæsarean section should be little. At the same time, as we have already stated, it is necessary to realise that we are dealing with human temperaments and human emotions, and in subsequent cæsarean sections we are inclined to leave it to the patient to decide after the case has been fully presented to her, whether sterilisation should be effected or not.

Where sterilisation is indicated or demanded, the method employed should be such as to leave no possibilities of a subsequent pregnancy occurring. Mere ligation of the tubes or even resection of a portion of the tube is not absolutely certain. The best method is to remove the whole Fallopian tube, including the interstitial portion, by excising the uterine cornu, invaginate the stump of the broad ligament and close up the incision by means of sutures.

Pomeroy's technique, which is easier to perform is satisfactory but has a failure rate of less than 0.5%. We are convinced of its effectiveness as far as tubal sterilisation goes.

We do not recommend supravaginal or total hysterectomy for this purpose. We believe that a hysterectomy is an unnecessary procedure purely for purposes of sterilisation.

Maternal and Fœtal Mortality. These are influenced by the conditions necessitating the operation. In elective operations the mortality for both mother and child is negligible. The overall maternal mortality in 3074 cæsarean sections was 1.4%. This fairly high mortality is due to lack of antenatal care because of which patients are brought in late in labour suffering from a variety of complications—ante partum hæmorrhage, intra partum infection and the like. Fœtal mortality also is influenced by these factors. In uncomplicated elective sections the fœtal mortality is comparable to uncomplicated vaginal delivery.

Pregnancy and Labour following Cæsarean Section. It is conceded that there has been of late a general increase in the incidence of cæsarean section. It is also conceded that this increased incidence has also contributed to a significant reduction in maternal and perinatal mortality. Even so, it is necessary to evaluate the obstetric future of a woman after a previous cæsarean section before we can feel happy about the immediate results of cæsarean section.

Many problems arise after cæsarean section. The first is the incidence of sterility after the operation. There is no proof that cæsarean section *per se* contributes to lowered fertility rate. It may do so if infection takes place. But what happens more often is that a woman is so anxious regarding the outcome in a subsequent pregnancy that she tries to avoid it. In other words, it is mostly a voluntary sterility. With each operation the patient gets so psychologically traumatised that she dreads another pregnancy and quite a number resort to contraception.

When pregnancy occurs in these patients there is no proof that the incidence of abortion is greater than in a normal patient. But during pregnancy she is liable to rupture of the uterine scar.

Rupture of the scar in pregnancy mostly occurs after a classical cæsarean section. The reason for this rupture is said to be imperfect healing of the wound in the upper segment during the puerperium. If the placenta is anterior, the chances of rupture are greater. If infection has occurred in the puerperium, the scar is weaker : also if the suturing is not done with sufficient care and precision. Even after all care is taken rupture of the classical section scar does occur in pregnancy and also during labour. On the other hand, rupture of the lower segment cæsarean section scar during pregnancy is rare. It occurs mostly during labour and its incidence is far less than after the classical operation. Classical section is therefore rarely employed in modern obstetrics.

The diagnosis and management of scar ruptures have been dealt with in the chapter on ' Injuries to the genital tract '.

Management. In the management of pregnancy and labour following cæsarean section, the following particulars have to be taken into consideration before arriving at a decision :—

(1) The indication for the previous cæsarean section.

(2) The type of section.

(3) The post-operative period and convalescence.

(4) The findings at obstetric examination during the subsequent pregnancy and whether the patient has had previous vaginal deliveries or not.

(1) *The indications for the previous section.* If the previous cæsarean section has been done for a contracted pelvis, it would be wise to do an elective repeat cæsarean section at term in the subsequent pregnancy, unless premature labour supervenes and the baby is small with no disproportion. In other words, persisting indication should be dealt with by repeat cæsarean section. On the other hand, quite a number of cæsarean sections are now being done for uterine dysfunction, toxæmias of pregnancy, antepartum hæmorrhage, malpresentations, fetal distress and other non-recurring indications. When the previous section has been done for any such indication, one could try to deliver *per vaginam* in the subsequent pregnancy.

(2) *The type of section.* Incidence of scar rupture is greater with the classical operation. In a series of 712 post-cæsarean deliveries the corrected overall incidence of classical scar rupture was 5.6% and for the lower segment section 1.8%. These figures are high when compared with reports from other countries. The reason is two-fold.

(i) It is not at all uncommon for patients to be admitted into hospital after a previous section done elsewhere about which data of any kind are not available—not even the type of section. (ii) Quite a number come in only after labour has commenced or rupture has occurred. These are factors over which we have no control. Our figures also prove that after a lower segment section one can with greater confidence permit vaginal delivery than after classical.

(3) *The post-operative convalescence.* This point has been laboured too much. All agree that a septic puerperium may result in bad healing and hence a weak scar. On this basis alone, many prefer to do elective cæsarean without permitting a vaginal delivery. However, even a normal post-operative period is no guarantee against rupture. Ruptures after quite uneventful post-operative convalescence have been observed; also successful vaginal deliveries in patients with infection after cæsarean section. There may be other factors involved than wound healing in rupture. One of the methods suggested for finding out good healing of the wound in lower segment operation is by hystero-gram done three to four months after the operation. The hystero-gram, especially a lateral view, may show projections which are said to be due to protrusion of the mucosa through a weak scar. Opinions are however divided and controversial.

(4) *The findings at obstetric examination at term in the subsequent pregnancy.* If the previous operation was done for a non-recurring indication and at term in the subsequent pregnancy, an average-sized fœtus is found presenting by the vertex with the maternal pelvis adequate at all levels, vaginal delivery may be permitted. Should, however, the pelvis be suspect or there is a minor cephalopelvic disproportion, it would be safer to do an elective cæsarean section. Trial labour for disproportion is best avoided in post-cæsarean pregnancies.

Malpresentation—a persistent shoulder presentation at term after a previous section—is best dealt with by elective cæsarean section. If a classical section has been performed, external version to correct the malpresentation is contra-indicated. We are not against attempting external version with great care if the cæsarean section was a lower segment one. Breech presentation *per se* is not an indication for elective repeat cæsarean section, if the baby is average in size and pelvis adequate. Especially in women who had previous vaginal deliveries, we are in favour of vaginal delivery. Mento-anterior presentations are permitted vaginal delivery, while elective repeat section would be safer in mento-posterior and brow presentations.

It should also be borne in mind that the prognosis for vaginal delivery is much better in women who had previous vaginal deliveries prior to the section.

From what has been stated, it will be seen that patients after classical section require careful watch not only during pregnancy but also in labour, while after a lower segment section one has a less anxious time in pregnancy and labour.

Management. During pregnancy the classical scar gives way usually between the 32nd and 38th weeks. Sometimes it may occur much earlier, as early as 20 weeks. These patients require frequent antenatal supervision and it is best they are admitted into hospital by the 34th week. When they reach term, a decision is taken on the basis of the factors discussed previously—whether they are to be dealt with by elective section or permitted vaginal delivery. The lower segment cæsarean cases also should be admitted into hospital near term and dealt with on similar lines.

The ever-present danger is rupture of the scar. If labour does not start spontaneously at term, the question of induction arises. We are not much in favour of induction in these cases, except when the head is engaged and the cervix is found effaced on vaginal examination. Induction is not recommended until at least ten days have lapsed after the expected date of confinement. For induction, artificial rupture of the membranes below the level of the presenting part is safer. If within a few hours of artificial rupture of the membranes, labour is not established, cæsarean section should be done.

When spontaneous labour does not set in and the patient has gone beyond the due date by a week or ten days, especially if the head is unengaged, elective section is the safer method. Induction is best avoided in post-cæsarean deliveries beyond term where the head is floating or not fixed.

When at the commencement of labour or even before, the vertex is found to be engaged and if during labour the pains are strong and normal, the prognosis for vaginal delivery is good. Where, however, the vertex is unengaged, pains are weak and the membranes rupture prematurely, often cæsarean section has to be resorted to at a later stage.

During labour the patient requires careful watch. The fœtal heart and maternal pulse should be recorded frequently—the former every 15 minutes and the latter every half hour. Irregularities of the fœtal heart, pain and tenderness over the upper segment in classical section and over the hypogastrium in lower segment cases, vaginal bleeding or blood-stained urine, increase in maternal pulse rate should all be regarded as signs of commencing rupture. Labour should then be terminated forthwith. Sedatives will be required in the first stage to allay apprehension. In cases progressing satisfactorily, once the head

comes on to the perineum, delivery may be completed by outlet forceps. If the placenta is expelled easily, there is no extra blood loss and the patient's condition as judged by blood-pressure and pulse rate is satisfactory, the uterus need not be explored. If there is delay in the separation of the placenta or there has been fairly heavy blood loss and the patient shows evidence of it, then the uterus is explored for any evidence for rupture. Ergometrine or Methergine 0.25 mgm. is routinely given intravenously to these cases at the time of delivery of the head.

When progress is unsatisfactory due to inefficient uterine action, and this is often found in association with premature rupture of the membranes and unengaged head, it is safer to effect delivery by cæsarean section within eight to ten hours of the onset of labour. Close observation is required throughout labour. Intelligent attention is required to spot the early signs of commencing rupture and in making a decision whether to terminate labour by cæsarean section or allow the patient to continue in labour. The operating theatre must always be ready for emergency section, as also compatible blood for transfusion. Once rupture occurs, the management of the case is as discussed under rupture of the uterus.

The use of oxytocin drip in those cases with inefficient uterine action is controversial. There are many who hold the view that oxytocin drip should not be employed in patients with a cæsarean section scar as the danger of the rupture of the scar is great. There is no doubt that in post-cæsarean deliveries the oxytocin drip if employed requires constant and expert attention. We are not averse to its use in patients where the vertex is almost engaged and uterine action is weak after rupture of membranes. From experience we have learnt that the oxytocin drip may do harm—if used in patients with weak pains with the vertex still at the brim or high in the cavity the membranes having ruptured prematurely.

During a 7-year period there were 712 post-cæsarean deliveries in the Madras Government Maternity Hospital. There were among them 226 patients after previous classical section, 442, after a previous lower segment operation and in 44 the type of section was not known nor were any data available. 190 of these were delivered by elective cæsarean section, while 504 patients (18 having been admitted after rupture of the scars) were put down for vaginal delivery. Among these 323 (64.1%) had a successful vaginal delivery with a perinatal loss of 4.2% and no maternal deaths. 181 patients had to be delivered by abdominal route for various indications, including 18 scar ruptures—an incidence of 3.8%. Of the 323 successfully delivered patients, 2 had rupture of the lower segment scar. Thus the overall incidence of scar rupture in labour was 3.8%. The maximum incidence of

rupture of the scar during pregnancy and labour occurred in the classical section group, being three times that occurring in the lower segment section cases.

We do not subscribe to the view once a cæsarean section it should always be a cæsarean section. There is no doubt that all post-cæsarean deliveries should only be in hospitals. And because of extenuating circumstances and the rather high incidence of scar rupture, it behoves us to give very careful thought before we embark on the first cæsarean section and not rush into it because of its immediate safety under modern conditions.

ENLARGEMENT OF THE PELVIC CAVITY

OPERATIVE methods are employed to obtain enlargement of the pelvic cavity. The two well-known methods are (1) Symphysiotomy and (2) Pubiotomy.

Symphysiotomy. This operation is now seldom performed except in Latin American countries, Dublin and in some parts of Africa. Its main advantage is that a permanent enlargement of the pelvic capacity is obtained which helps to avoid cæsarean section.

The indication for operation is usually milder degrees of contraction in the cavity and outlet. However, there are obstetricians who believe that it can be done even in minor degrees of contraction of the brim as they believe that the operation results in increase in pelvic capacity at all levels.

Technique. It is performed under local anæsthesia and the subcutaneous method is preferred. The legs are supported in the lithotomy position at an angle of 80° . A number 20 Foley's catheter is placed in the urethra and the bladder emptied. The skin of the anterior abdominal wall an inch and a half above the symphysis pubis, is drawn down so as to lie over the symphysis. A small transverse incision is made about half an inch in length and the blade of the knife passed through this incised wound, its flat surface being closely applied to the anterior surface of the symphysis. The knife is then turned at right angles, and with the cutting edge the symphysis pubis is gradually cut through. With a finger inserted in the vagina this can be controlled so that only the joint and the sub-pubic ligament are divided. Before final separation of the symphysis pubis, care must be taken to see that the assistant on either side holds the hips pressed inwards, thereby preventing sudden flaring out of the iliac bones as the two pelvic bones spring apart. After division of the symphysis pubis, the knife is removed. If the cervix is fully dilated at the time of symphysiotomy the delivery can be completed by vacuum extraction or forceps under pudendal block anæsthesia and episiotomy. Spontaneous delivery also may be awaited. After completion of delivery the legs should be kept strapped together for 24 hours. Bladder should be kept continuously drained for 3-4 days. A broad belt may help ambulation which in uncomplicated cases begins on the 5th-7th

day. Complications include hæmatoma, sepsis, stress incontinence, pelvic pain and backache.

Symphysiotomy should only be performed in cases of established obstruction due to mild contraction of the pelvic cavity or outlet and not as a prophylactic procedure. Marked degree of contraction at any level is a contra-indication as also a large baby. The operation should not be performed in the presence of a breech or brow presentation. Previous cæsarean section for disproportion is also a contra-indication for the operation.

Because of the safety of the lower segment cæsarean section done even late in labour under modern conditions symphysiotomy is now seldom practised. But as it helps to avoid cæsarean section it could find a place in the hands of highly skilled obstetricians practising in the developing regions of the world where antenatal care is seldom available.

Pubiotomy is an operation which is attended by a high risk of osteomyelitis and has now been abandoned.

INDUCTION OF ABORTION AND LABOUR

UNDER certain circumstances it is necessary to induce abortion or labour.

Induction of Abortion

This term should, strictly speaking, be applied to the artificial interruption of pregnancy and evacuation of the uterus performed within the first twelve weeks of pregnancy or before the full formation of the placenta ; but in practice it is extended to include evacuation of the uterus before the twenty-eighth week of pregnancy ; in other words, before the fœtus is viable.

Indications. The indications for this operation must be clearly defined, and it is advisable in every case, where abortion is to be induced that the practitioner protects himself from the charge of unjustifiable interference by conscientiously considering all the factors indicating the necessity for induction, as well as by obtaining a second and independent medical opinion in writing. With a clearer realisation of the possibilities of conservative treatment to enable pregnancy to continue, the indications for induction of abortion are becoming more and more limited.

Improvements in therapy have vastly reduced the indications for induction of abortion. When pregnancy is terminated in the interests of the mother, it is termed therapeutic abortion. Most of the indications for therapeutic abortion in the past are now no longer considered as such, as by medical or surgical management, the mother's life can be saved and the pregnancy permitted to continue. Some of the present indications for therapeutic abortion are—

(1) **Hyperemesis Gravidarum.** In the severe cases of hyperemesis which is seldom seen these days—where, in spite of energetic treatment, the patient shows deterioration in her condition—pregnancy will have to be terminated. It is safer to induce abortion a little earlier rather than too late when even termination of pregnancy may not help.

(2) **Cardiac Disease.** Rarely is termination of pregnancy indicated when pregnancy occurs in a patient with heart disease. There may be justification in resorting to termination of pregnancy

when there is a history of repeated attacks of decompensation in previous pregnancies in a multipara and then only if the patient is seen in the first trimester. After the 12th week of pregnancy it is advisable not to interfere with the pregnancy. Cardiac surgery has to a great extent replaced therapeutic abortion in these cases.

(3) **Pulmonary Tuberculosis.** This was at one time considered as a definite indication for termination of pregnancy. The present position is there is no indication for therapeutic abortion in these cases and one should ignore the pregnancy and treat the tuberculosis effectively. There may be however instances where because of socio-economic circumstances which make it difficult for the pregnant mother to have the necessary attention and treatment, abortion may be induced. It must be clearly understood that the indication is a socio-economic one and not pulmonary tuberculosis.

(4) **Hypertensive and Renal Disease.** In women with a sufficient number of children who are suffering from chronic nephritis or malignant hypertension it would be advisable to terminate pregnancy if seen in the first trimester.

(5) **Iatrogenic Disorders and Chromosomal Abnormalities.** Acute viral infection of the mother especially Rubella if it occurs very early in pregnancy often results in congenital malformations of the foetus. Certain drugs consumed by the patient during early weeks of gestation also have similar effects. A well-known example is Thalidomide.

A history of Rubella infection in the early weeks of pregnancy (especially prior to 10 weeks) and consumption of drugs with known iatrogenic effects are now considered as indications for induction of abortion.

Chromosomal and enzyme abnormalities have now been identified as factors responsible for transmission of certain inherited disorders. Some of these disorders may also be sex-linked. It is possible to determine by examination of the liquor amni whether the intra-uterine foetus will be affected or not. If investigations yield a positive result, it is now the practice to induce abortion. Sex-linked diseases like hæmophilia, progressive muscular atrophy and chromosomal abnormalities resulting in various genetically induced disease can now be diagnosed early and therapeutic abortion performed.

(6) **Psychiatric Disorders.** This is a questionable indication. But it is accepted as an indication if a board of medical and psychiatric specialists certify that the pregnancy will exacerbate the mental condition of the patient.

Methods. (1) *Dilatation of the cervical canal, with evacuation of the uterus by the finger or the curette.* This method of evacuation may be adopted before the twelfth week of pregnancy in suitable cases. The patient is anæsthetised and prepared with all due aseptic and anti-septic precautions; the cervix is dilated by Hegar's or Mathews-Duncan's dilators sufficiently to admit the finger freely. The index finger is then introduced through the cervical canal and the ovum is gently separated from the uterus. After separation of the ovum, an ovum forceps is passed into the uterus, the ovum grasped and removed by gentle twisting and traction. The ordinary ovum forceps is, however, often too big to be introduced with the dilatation that has been effected, and we have found the ordinary sponge forceps quite as effective to grasp and remove the ovum. After this has been removed a blunt flushing curette may be introduced into the uterus and the uterus gently curetted and flushed out. It is always necessary to verify, by passing the finger again into the uterine cavity, if all the products of conception have been completely removed. This precaution is advisable, as not infrequently the use of the curette leaves behind bits of placenta which keep up bleeding and later decompose and give rise to sepsis.

(2) *Gradual dilatation of the cervical canal by Laminaria tents.* In this method the cervix is dilated up to No. 12 size of Mathews-Duncan's dilator, and one or two laminaria tents, properly sterilised, are introduced into the cervical canal, so that their tips lie beyond the internal os, and are left *in situ* for twelve to twenty-four hours. The cervix is gradually dilated as the tents swell by absorbing moisture, uterine contractions are provoked, and at the end of the period, the tents are removed and the uterus evacuated in the manner already described above, as after twenty-four hours, cervical dilatation permits the introduction of one finger. This method should be adopted in cases where there is no great hurry and in those in whom the cervix is not easy of dilatation. The chances of infection are greater and on general principles the one stage evacuation if possible should be preferred.

(3) *Vaginal Hysterotomy.* This is a method of evacuation which is rapid and certain. In cases where it is not possible to dilate the cervix sufficiently to complete the evacuation at one sitting, vaginal hysterotomy is indicated, especially when the pregnancy has gone beyond 16 weeks. Particularly in multiparous women it is a safe operation and gives excellent results.

Technique. A transverse incision is made across the front of the cervix just below the attachment of the anterior vaginal wall. The vesico-cervical space is then opened into and the anterior vaginal wall along with the bladder is pushed right up till the utero-vesical fold of

the peritoneum is exposed. The cervix is then incised anteriorly in the middle line till the level of the internal os is reached. 0.25 mg. methergine is given intravenously to the patient prior to evacuation of the

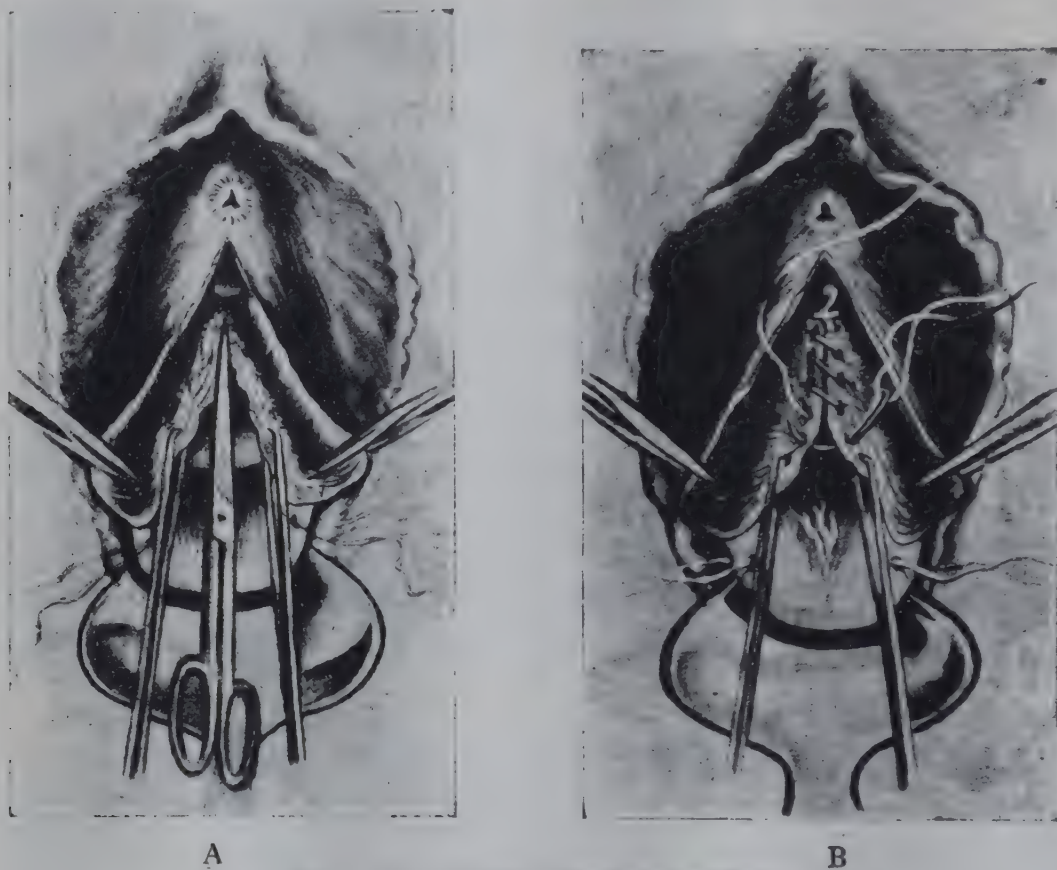


FIG. 167.—Vaginal cæsarean section.

A. Incision on the cervix and lower uterine segment.

B. The suturing-up of the cervix and lower uterine segment after delivery.

uterine contents which is done by the fingers. After emptying the uterus completely, the incision in the cervix is closed by catgut sutures, as also the incision in the vagina.

(4) *Abdominal Hysterotomy*. This method of evacuation in the second trimester of pregnancy is becoming more and more popular, and deservedly so. The technique may be described as that of a miniature cæsarean section. It can be done in any case where a rapid method of evacuation, unattended with shock, is necessary. A distinct advantage is that the operation can be combined with that of sterilisation of the patient—a procedure necessary in certain cases where it is undertaken for grave complications, such as renal and cardiovascular diseases.

The technique of this operation is exactly similar to that of a cæsarean section. An incision is made in the upper uterine segment or lower segment, the uterus opened into, the contents evacuated, and the uterus closed with sutures which do not involve the endometrium.

(5) *Vacuum aspiration of the uterine cavity*. This method consists in producing a negative pressure in the uterine cavity by means of a

vacuum pump and aspiration of its contents through a curette or cannula introduced into the uterine cavity. Since 1963 this method has become more widely used in Eastern Europe and is being used in other parts of the world also though on a smaller scale to induce abortion.

Different types of apparatus and cannula have been employed. The principle is the same. Cannulas or curettes of different diameters are available for use according to duration of gestation. For early pregnancies (8-12 weeks) a 9 mm. cannula would be sufficient. Beyond 12 weeks sizes 11-13 mm. are preferable. The opening in the cannula is lateral though some have it at the end.

After dilatation of the cervix sufficient to introduce the chosen cannula, the latter is introduced into the uterine cavity and a negative pressure is created for evacuation of the contents. The pressure employed varies between (9-18 in. of Hg.) or 0.6 to 1 atmosphere. The contents are broken up by the aspiration and are collected in a bottle connected to the cannula. During the aspiration the cannula (suction curette) is moved gently up and down over all aspects of the uterine cavity. If the curette becomes blocked it is withdrawn until its mouth appears outside the cervix where normal pressure will clear it. If this is unsuccessful the blockage is cleared with forceps or by increasing the suction. During aspiration the uterus reacts by contracting and decreasing in volume. Aspiration takes usually 3-5 minutes and can be done if no dilatation is required without any anaesthesia. If anaesthesia is required, local, general, or paracervical block can be used.

This is a very useful method especially where the duration of pregnancy is not more than 12 weeks. Beyond it, the emptying of the uterus is often incomplete by this technique and may have to be completed by ordinary curettage. The advantages are ease of performance, less of blood loss and diminished dangers of perforation of the uterus as compared to ordinary dilatation and curettage.

Prostaglandins E₁ and E₂ administered as an intravenous drip have also been found successful in inducing abortions prior to 24 weeks. But the dosage required is higher than that required for induction of labour.

These drugs are now on trial. Published reports are encouraging.

In recent years there has been a great alteration in the obstetricians' attitude towards induction of abortion necessitated by changing outlook of society and socio-economic factors. In many countries the rigid laws regarding induction of abortion have been liberalised. It is also believed that such liberalisation will help in reducing the mortality from illegal abortions which is very common. In India it is estimated that about 3.8 million illegal abortions are performed annually.

The mortality is not known. The trend now is to permit abortion when—

(a) The continuance of pregnancy would involve serious risk to the life or grave injury to the health whether physical or mental of the pregnant woman whether before, at, or after birth.

(b) There is substantial risk that if the child was born it would suffer from such physical or mental abnormalities as to be seriously handicapped in life.

(c) Pregnancy results from rape, intercourse with an unmarried girl under the age of 16 or intercourse with a mentally defective woman.

(d) Pregnancy results from contraceptive failure.

More liberal laws in certain countries enable women to have an abortion on demand or at request. It is also stated that in a world where there is already a 'population explosion' induction of abortion could be employed as a method of reducing population growth.

Without entering into any controversy it is pointed out (1) Induction of abortion after 12 weeks of gestation is 5-6 times more risky than if carried out prior to 12 weeks.

(2) If the woman is not sterilised at the same time there is evidence that 49.5% becomes pregnant again during the year and about 23% more than twice within a period of 18 months.

(3) Even in the hands of specialists large scale abortions have a certain amount of risk which is not negligible—hæmorrhage, perforation of the uterus and infection being the causative factors.

(4) The late sequelæ of induced abortions especially if repeated do not allow of easy statistical evaluation. They are usually menstrual disorders, chronic pelvic pain, leucorrhœa and emotional disturbances.

In developing countries if a couple has had sufficient number of children—especially in poor socio-economic group—sterilisation of the husband or wife is preferable as it is more safe and effective.

Induction of Labour

Labour may be induced prematurely at or near term or after. In the former case, we speak of induction of premature labour, and in the latter, where a woman has already reached term or is possibly past the term, we speak of induction of labour.

Indications. (1) *Toxæmia of Pregnancy*. (Including hypertension, chronic glomerulo nephritis).

One of the very common indications for induction of premature labour is pre-eclamptic toxæmia. In the more severe grades of toxæmia not responding to treatment, premature labour is induced in order to save the mother from eclampsia and in those cases where the fœtus has already reached 38 weeks maturity to save it from intra-uterine death.

(2) *Antepartum Hæmorrhage*. In premature separation of the placenta which often occurs weeks before term it is necessary induce premature labour as a method of management. In the milder varieties of placenta prævia (Types I and II) to control bleeding, induction of premature labour is employed.

(3) *Hydramnios*. Premature labour is induced in cases of hydramnios with acute symptoms. In chronic hydramnios, rest and diuretics may be given a trial, before resorting to premature induction.

(4) *Habitual Intra-uterine Death of the Fœtus*. There are some patients who give a history of repeated intra-uterine death of the fœtus round about term. The ætiology of the condition is obscure. Under such circumstances induction of labour before the usual term of intra-uterine death is a useful procedure.

(5) *Excessive Size of the Fœtus*. In some women, with each pregnancy, the babies increase in size and weight, giving rise to an increasing degree of dystocia. To prevent such dystocia due to excessive size, labour could be induced earlier.

(6) *Rh-Incompatibility*. In Rh-negative women who harbour an Rh-positive fœtus, the titre of the agglutinin in the maternal blood should be periodically estimated during pregnancy. A rising titre should put the obstetrician on guard and in select cases induction of premature labour when the child is viable has been recommended as a means of shortening the exposure of the infant to maternal antibodies.

(7) *Diabetes and Pregnancy*. There is general agreement that, when diabetes complicates pregnancy, it is best to terminate pregnancy a few weeks before term. This will help to avoid intra-uterine death and dystocia due to large size of the child. Many favour cæsarean section. But where examination reveals satisfactory response to induction, the latter procedure may be employed.

(8) *Fœtal Monstrosities*. When malformations of the fœtus—hydrocephalous, anencephalous, achondroplasia, monsters—are diagnosed by radiography antepartum, it is best to terminate pregnancy by inducing labour.

(9) *Contracted Pelvis*. Induction of premature labour for contracted pelvis is often referred to as an essentially British procedure. The

aim is to obtain a smaller infant capable of being delivered *per vaginum*. Especially in the tropics, under existing conditions, induction of premature labour for disproportion in a primigravida is best avoided. It is far better to allow the woman to go to term and give her a trial labour. In a multigravida, with increasing dystocia due to a large child and disproportion, induction of premature labour is a useful procedure.

(10) *Intra-uterine Death of the Fœtus*. In most cases spontaneous expulsion of the dead fœtus occurs within three to five weeks of intra-uterine death. Sometimes it is retained for longer periods and it is now realised that such abnormally long retention may give rise to coagulation failure by the production of fibrinogenopenia in the mothers. Also certain patients are afraid of the effects of carrying a dead fœtus *in utero* and ask for help in emptying the uterus. A dead fœtus *in utero* may also get infected and give rise to clinical manifestation of toxic absorption. Hence induction of labour will be indicated in cases of intra-uterine death under the circumstances mentioned above.

Induction of Labour at Term or After. There are very few indications as such for induction of labour at term. However, in modern obstetrics, the procedure of 'Elective induction of labour' has found a place.

By elective induction is meant induction of labour at full term in persons who are completely normal and in whom the induction is undertaken as a matter of convenience. Certain conditions must be satisfied before undertaking elective induction.

(1) The obstetrician must be convinced of the maturity of the fœtus. From the history and his examination and any other investigation that is deemed necessary, he should be certain that the fœtus is at term.

(2) Cervix must be soft and effaced indicating quick response to induction.

(3) Presenting part must be vertex and if the head is not engaged it should at least be dipping well into the pelvis.

(4) There should be no abnormalities of any kind that might make labour even a little difficult.

There are a large number of reports lauding this procedure. When labour is induced at term in such patients, the perinatal mortality and maternal mortality and morbidity are in no way greater than in the group with spontaneous onset of labour. There are, in addition, according to those who practise it, certain definite advantages. The greatest advantage is that the patients can be brought into hospital for

confinement by appointment, labour induced and delivery conducted as a planned procedure. The alternative is to bring the patient in, as an emergency when labour starts at odd hours or keep her in hospital for days together prior to labour and thus hold up beds unnecessarily. There are many who support this procedure. We believe that unnecessary interference in spite of the safety under modern conditions is unwarranted. There is no objection in adopting this procedure in select cases, but we hesitate to recommend it as a routine procedure at term.

Post-maturity. When pregnancy has gone beyond term, labour should be induced. This, in fact, is the main indication for induction of labour in many clinics. Here again it is necessary to be convinced of the maturity of the fœtus. We do not induce labour until the patient has gone beyond her expected date by at least 10-14 days.

Methods. Only two methods in use at the present time are discussed :

- (1) The oxytocin drip.
- (2) Surgical induction—amniotomy.

(1) *The Oxytocin Drip.* The oxytocin drip is based on the assumption that oxytocin is the hormone provided by nature to initiate labour and effect delivery. Till Theobald demonstrated the use of oxytocin as a drip, it was administered in fractional doses. A commonly employed procedure was to give 3-5 units intramuscularly every half hour till 10-15 units were given or till labour was established. The disadvantage of this technique was that there was no control over the action of the uterus once the injection was given. All uteri do not respond in the same way to injection of oxytocin. Some of them respond with very powerful tetanic contractions resulting in either intra-uterine death of the fœtus or sometimes even rupture of the uterus. By administering oxytocin intravenously in what Theobald calls a 'physiological drip' the obstetrician is able to control its action completely. He can stop or enhance the contractions at will and adjust the rate of the drip in such a way that almost normal physiological contractions of labour are produced. For greater safety the uterine contractions can be recorded by means of a tokograph or tokodynamometer and of late the fœtal cardiophonograph has added greater safety by the accurate recording of the fœtal heart during the time the drip is flowing.

Pitocin was employed at the start. A synthetic oxytocin is now available—Syntocinon—equally potent, unit for unit, and much cheaper. Hence when the term oxytocin is used it may refer to either Pitocin or Syntocinon.

The Oxytocin Sensitivity Test. This is a useful test which helps in assessing the irritability of the uterus. Increasing uterine irritability results in labour. The amount of oxytocin required by a patient to noticeably increase uterine activity forms a method of assessing irritability and has useful clinical applications.

The test, according to Nixon and Smith who invented it, is carried out as follows:—

The patient is in bed and at rest. If a tokograph is available it could with great benefit be employed to record the contractions. If it is not available, one has to depend on clinical impression as obtained by keeping the hand over the uterus. Oxytocin at 0.01 unit per ml. is prepared in 10 ml. syringe and the injection commenced at the end of a spontaneous contraction. The 0.01 unit is injected intravenously at minute intervals until a contraction occurs. The total dose given to this point is called the oxytocin sensitivity. The intensity of the contraction elicited can be noted and is often found to be much stronger than the spontaneous contractions which preceded the test. It has been found that patients on the verge of labour respond strongly but safely to doses of 0.01 units oxytocin, while other patients will require doses upto 0.1 unit. The measurement is therefore made between these limits. Studies have shown that it is advisable to consider patients sensitive to 0.04 units oxytocin or less as suitable for surgical induction—that is they are very likely to go into labour within 24 hours after induction. Those who require more than 0.04 units to produce a contraction should be treated first with an oxytocin infusion and the amniotomy postponed until the uterus has become more sensitive.

Induction by the Oxytocin Drip. Prior to the start of induction the bowels are cleared by a large soap and water enema. Various dilutions of oxytocin have been employed. We use $2\frac{1}{2}$ units of Syntocinon in 500 ml. of 5% glucose, i.e., a dilution of 1 in 2000. The drip is first run in slowly at the rate of 10 drops a minute. The rate of the drip is gradually increased till normal uterine contractions lasting half to one second at intervals of one to two minutes are produced and maintained. A medical officer stays with the patient watching the contractions, adjusting the rate of the drip and recording the foetal heart every half hour. In some, the rate of the drip may even go up to 80-100 drops a minute and still no contractions may occur. In successful cases labour is established by the time the first 500 ml. is over. In some, a second and third drip may be necessary. Not more than 10 units are given in the drip during twenty-four hours. If labour is not established, it is classed as a failure. It is attempted again a day or two later or if the indication is urgent one has to resort to other methods.

Oxytocin drip is often a success when the head is engaged and the cervix effaced. Where the cervix is closed and long and the head unengaged, by itself it is not often successful. But it does help to soften the cervix, and help its effacement so that amniotomy can be safely performed.

Some advocate stretching the cervix to admit a finger, stripping and separating the membranes all round the internal os and then starting the oxytocin drip. These procedures are all useful, but much depends on the urgency of the indication. However, it should be remembered that oxytocin drip is most effective after amniotomy.

(2) *Surgical Induction.* The one method that is now employed is amniotomy or otherwise termed artificial rupture of the membranes. The exact mechanism by which amniotomy induces labour is controversial. Current opinion holds that as a result of the rupture of the membranes resulting in removal of most of the liquor, the presenting part, usually the vertex, comes into intimate contact with the lower uterine segment and the cervix, resulting in the stimulation of the nerve plexus and ganglia situated in that region which provoke uterine contractions. Amniotomy can be done below the level of the presenting part when it is termed low rupture and also above it when it is termed high rupture. Usually, after amniotomy, there is a variable interval—the latent period—before labour starts. This latent period is influenced by certain factors. They are :

(1) *The level of the vertex.* If the head is engaged, the latent period is much shorter than when it is not. With a floating head the latent period tends to be very much longer.

(2) *The nature of the cervix.* A thinned out effaced cervix with the external os admitting a finger will respond to induction most satisfactorily. The latent period is very short in these cases. If the cervix is long, uneffaced and closed, response to induction is delayed and the latent period considerably longer. A soft gaping cervix, even though not effaced, has a better prognosis and shorter latent period than the one which is closed and long. When the external os is near the hollow of the sacrum or the symphysis, response to amniotomy is poor.

(3) *The term of pregnancy.* The nearer to term, the better is the response to induction and shorter the latent period. The latent period is invariably considerably prolonged in the majority of cases, if pregnancy is less than 34 weeks.

(4) With a well flexed vertex, the latent period is shorter than when it is a deflexed head or a breech or a face.

(5) *The site of artificial rupture of the membranes.* If the membranes are ruptured below the level of the presenting part—low rup-

ture—the latent period is shorter than when it is ruptured above the presenting part.

All these factors must be taken into consideration in deciding the mode of induction. The few disadvantages of this procedure are :—

(1) Infection. Intra-uterine infection is not an uncommon *sequela* of induction by amniotomy. This is more so in cases where there is a prolonged latent period, especially when it is beyond 48-72 hours. Unnecessary vaginal examination done by the anxious obstetrician does no good but produce intra-uterine infection. Because of this danger it is now a routine to commence prophylactic antibiotic therapy in all cases of amniotomy.

(2) Prolapse of the cord. One of the dangers is said to be the occurrence of prolapse of the cord when artificial rupture of the membranes is done below the presenting part when the presenting part is not engaged or fixed at the brim. In a large series of cases, where we have induced labour by amniotomy with unengaged heads, we have had no such complication. This complication is most likely to occur in cases of hydramnios, when, after rupture, the liquor flows out in force and may produce a prolapse of the cord. In cases of placenta prævia, there is a greater incidence of anomalies in the insertion of the cord and hence greater chance of prolapse of the cord occurring. This fact should be borne in mind. In hydramnios therefore it is best to induce labour by high rupture of the membranes. For all other indications low rupture is to be preferred.

The latent period which follows induction and onset of labour is dependent on various factors and also that the longer the latent period, the greater is the chance of intra-uterine infection. Hence it would be wise to reduce the length of the latent period and for this purpose the oxytocin drip is most suitable and efficient. The oxytocin drip acts better after rupture of the membranes. Hence the two may be combined in induction. The procedure is as follows :—

The patient is put in the lithotomy position and draped. A vaginal examination is made with all aseptic precautions. The nature of the cervix is assessed, as also the presentation and level of the presenting part (vertex). A finger is introduced into the cervical canal, if it is easily possible, and the membranes separated all round the internal os. A speculum is then introduced into the vagina, the cervix held up and the membranes are punctured below the presenting part by a sharp stilette. As much liquor as possible is let out and the small opening in the membranes enlarged by the fingers. The patient is then put to bed and prophylactic antibiotic therapy instituted. If labour pains do not start within a couple of hours, an oxytocin drip as described previously is started. There is no objection to start the drip

soon after amniotomy. With this procedure, namely amniotomy combined with oxytocin drip, the success rate is high. At times two or three drips may have to be used. Even so, there have been instances where labour could not be established even after these procedures and it had to be terminated by cæsarean section.

Amniotomy and oxytocin drip are relatively safe and effective procedures.

Buccal oxytocin. Tablets of oxytocin containing 200 units may be given by mouth and repeated until labour is established. Between 1000 and 2000 units are required and this renders the method expensive. Furthermore it is often difficult to control the rate of absorption and uterine tetany can occur with the threat of fetal anoxia and uterine rupture.

Prostaglandins. Prostaglandins is a generic term for a group of closely related derivatives of prostanoic acid. It is found widely distributed in mammalian tissues particularly in the human seminal fluid and are believed to be responsible for a wide range of biological activity. There are about 14 naturally occurring prostaglandins. Prostaglandin E and F stimulate uterine contractions during pregnancy when given intravenously. Recent investigations have shown that prostaglandins E (E_1 or E_2) and F_2 is of value and safe in inducing labour. The drug is given as an intravenous drip—similar to oxytocin drip.

Different rates of infusion have been employed ranging from 0.05 ug/kg min of F_2 to 2-6 ug/min of E_1 and E_2 . Good results have been reported—the induction delivery interval in successful cases ranging from 2-20 hours.

Intra amniotic injection of hypertonic saline or glucose— We have discussed this procedure in detail and its results under 'intra uterine death of the fetus'.

SECTION IX

PATHOLOGY OF PUERPERIUM

CHAPTER LVII

PUERPERAL INFECTION

Puerperal infection. Under the heading are included the various pyrexial conditions which complicate the puerperium. Puerperal fever is defined as any pyrexia of 38°C (100.4°F) occurring on one or more occasions of the first ten days post-partum exclusive of the first 24 hours.

Predisposing causes. After parturition there is always an open wound namely the placental site. The addition of other open wounds such as lacerations of perineum, vagina or cervix will naturally increase the liability to infection and must be included as predisposing causes. Apart from it repeated vaginal examinations done in labour without proper precautions and intra-uterine manipulations predispose to infection. Furthermore women in whom the natural resistance is lowered are more liable to infection. Such patients include those with anæmia, hæmorrhage (ante or post-partum), general ill-health, pre-eclampsia, diabetes mellitus and nephritis—to mention a few.

Exciting causes. The direct cause of puerperal sepsis is an invasion by bacteria. To a great extent the infection is dependent on the amount of care with which the delivery has been conducted. If vaginal examinations, instrumental deliveries or other manipulations have been performed without due aseptic or antiseptic precautions the chances of infection are greater. Among other factors which play a part in the introduction of sepsis perhaps the most important is the dissemination of bacteria from the throats and noses of the attendants by contamination of the hands and by 'droplet infection' sprayed

into the genital tract by talking and coughing. To obviate this it is the modern practice that all in attendance on a patient in labour should wear masks. All these together form the exogenous sources of infection and this constitutes the majority in puerperal infection.

Virulent microorganisms may be present in the vagina before the onset of labour. The trauma of labour allows these bacteria to multiply and to cause a clinical infection. This type of infection is termed endogenous. Such endogenous infection may also originate from other areas in the system via blood stream or lymphatics.

Infecting organisms. These include the streptococcus (hæmolytic, non-hæmolytic, aerobic or anærobic) staphylococcus aureus, bacillus colli, clostridium welchii and occasionally other organisms like bacillus tetanus. The commonest of these are the streptococcus (hæmolytic and non-hæmolytic), B. colli and staphylococci. Anærobic streptococci a normal habitant of the vagina may in the presence of damaged tissue take on pathogenic activity. The common modes of spread are :

(1) Direct spread along the endometrial surface on to the tubes and ovaries and pelvic peritonium.

(2) Via lymphatics especially—when there are cervical lacerations infection may spread into the pelvic cellular tissue.

(3) Blood stream infection giving rise to septicæmia.

(4) Venous spread—Thrombi in the veins may get infected and the infection may then spread along venous channels.

Clinical classification. Puerperal pyrexia may be due to infection of the genital tract, acute mastitis, infection of the urinary tract, thrombophlebitis and other general systemic infections which are unrelated to parturition—e.g. typhoid, pneumonia, malaria to mention a few.

Investigation. In all cases a culture from the upper part of the vagina must be taken and in severe cases blood culture also. The sensitivity of the organisms to antibiotics should also be tested. A catheter specimen of the urine should be examined microscopically for pus cells and also investigated bacteriologically. In areas where typhoid, malaria and other fevers are prevalent investigation to rule out these may have to be carried out e.g. examination of blood smear for malarial parasite, blood culture for B. typhosus or later widal reaction. The abdomen should be palpated for signs of general peritonitis and vaginal and rectal examinations made to identify pelvic inflammatory masses. Finally the breasts must be examined for signs of infection.

Signs and symptoms. Genital tract infection—This may be in the form of local wound sepsis of the perineum, vagina and uterus. Further spread may cause a blood stream infection (septicæmia) or involvement of the peritoneum—general peritonitis. Spread of the infection within the pelvis may involve the tubes, ovaries, pelvic cellular tissues or pelvic peritoneum or pelvic veins.

The first indication of infection is a rise in temperature, usually on the second or third day. Even in cases of local infection a rigor may occur occasionally but repeated rigors would be in favour of the infection having spread to the blood stream. The lochia in local infection is often profuse and offensive while in blood stream infection it may be even suppressed. The severity of the infection depends upon the organisms involved as identified by culture. If hæmolytic streptococci is found the disease is potentially serious but if a less virulent organism is grown the patient will almost certainly succeed in localising the infection.

Septicæmia should be suspected if the temperature is high, pulse is over 110 and repeated rigors are present. It can be proved only by finding a positive blood culture.

General peritonitis should be suspected when there is distension and tenderness of the abdomen and perhaps diarrhœa.

Salpingo-oophoritis and pelvic cellulitis usually occur in a combined form. Ordinarily salpingo-oophoritis occurs earlier except in the presence of infected cervical lacerations when pelvic cellulitis is more common. Spread of infection to these structures is indicated by pain, persistent or increasing temperature and finding of a bilateral or occasionally unilateral mass in the fornices on vaginal examination.

Sometimes a pelvic abscess may form which may burst into the rectum or point anywhere along the course of the pelvic cellular tissue, commonly over the inguinal region and sometimes even in the perinephric region. Usually where the tubes and ovaries as well as the pelvic cellular tissues are involved invariably there is a certain amount of pelvic peritonitis as manifested by lower abdominal pain and distension, along with a rise in temperature.

Pyæmia is a manifestation of severe infection of the thrombi in the veins. The common venous channels through which the infected thrombi may spread are the ovarian and uterine veins and later the hypogastric, external iliac or femoral veins may be involved. Clinically this is manifested by high fever, severe repeated rigors, sweating and rapid pulse. The infected thrombi may lodge in the lungs, kidneys, joints brain and subcutaneous tissues giving rise to abscesses.

The clinical picture of puerperal infection has been dramatically changed during recent years by the introduction of potent antibiotics which are now often given with the onset of pyrexia. The infection in consequence remains localised and quickly resolves. The pelvic organs are not damaged and fertility is thus not impaired.

Treatment. All cases must be treated as infectious and is best isolated. The patients should be nursed in a warm well ventilated room and as nourishing a diet as can be assimilated should be given. It is now common to start treating these patients with penicillin as soon as specimens have been collected for culture and sensitively test. Penicillin is usually given in large doses 500,000 units of crystalline penicillin four times daily. In severe cases particularly for cases of *Cl. Welchii* infection larger doses may be given. This is one type of infection in which an antiserum—antigas serum—is a useful addition. Once the results of sensitivity tests are obtained the appropriate antibiotic should be employed. Tetracycline, chloramphenicol, streptomycin, ampicillin, erythromycin are some of the many available which are used in clinical practice. They may be given parenterally or by mouth.

When the infection is long standing anæmia will develop and this is corrected by repeated fresh blood transfusions. If a pelvic abscess develops and does not respond to antibiotics it should be surgically drained either through the vagina or the abdominal wall depending upon its localisation. Hysterectomy is seldom performed for puerperal infection. Occasionally in severe cases of *cl-welchi* infection with retained fragments of placental tissue hysterectomy has been carried out and some good results have been reported. Hysterectomy is justified when puerperium is complicated by infected fibromyoma or placenta accreta.

Venous complications in the Puerperium. These include thrombosis and phlebitis of the superficial and the deep veins of the lower extremities. Pre-existing varicosities usually get inflamed when the superficial veins are affected.

Venous thrombosis is divisible into (1) Simple thrombosis, Phlebothrombosis and (2) inflammatory thrombosis—thrombophlebitis. Phlebothrombosis may, through inflammation, become thrombophlebitis.

Phlebothrombosis. In this condition intravenous clotting occurs without previous infective lesion and with minimum inflammatory reaction. The thrombi are loose and liable to become detached and cause pulmonary embolism. This condition is more common after gynæcological operations than in the puerperium.

It occurs in the legs in two forms—the superficial and deep. When varicose veins are present, superficial phlebothrombosis occurs in them. The thrombosis may sometimes spread up the saphenous vein to the femoral and iliac veins and then embolism may occur. This is, however, rare. The onset is usually about the fourth, or the fifth day of the puerperium. There may be slight rise in temperature and pulse rate and the affected veins are hard and tender to touch. With rest and antibiotics the condition usually subsides within a fortnight, often with obstruction of the varicosities.

Deep phlebothrombosis begins in the deep veins of the calf or soles of the feet and extends upwards. It is often symptomless. Sometimes the patient complains of pain in the calf or sole which may be tender on pressure. Sharp dorsiflexion of the foot elicits pain in the calf. This is termed Homan's sign. It is, however, not always present. There may be slight rise in temperature and pulse rate, with no obvious cause, usually about the seventh to tenth day of the puerperium. These early signs may very often be missed. The condition may then first become manifest when pulmonary embolism occurs or when generalised œdema of the leg sets in.

If the embolus is not a small one, the patient will present the classical picture of sudden pain in the chest, dyspnœa, cough and blood-stained sputum. Auscultation may reveal a pleural rub and an area of consolidation. Radiographs of the chest may show a wedge-shaped shadow. In massive embolism, death occurs within a few minutes.

Thrombophlebitis. This is infective in origin. The primary site is commonly the uterus. The organism concerned is usually an anærobic *Streptococcus*. Anæmia particularly predisposes to this type of infection. It may occur in the femoral vein by retrograde spread from pelvic thrombophlebitis or by direct spread from adjacent cellulitis. It may also be an extension of thrombophlebitis lower in the leg. Embolism is uncommon in this condition, because, as a result of infection, the thrombi are adherent to the vein walls. There is always surrounding periphlebitis.

The onset is often in the second or third week of the puerperium with chill, fever and pain along the affected segment of the vein. Œdema of the whole leg follows rapidly. If the condition primarily affects the femoral vein, the swelling usually begins in the foot and spreads upwards. Often there is secondary arterial spasm leading to pallor and cold in the swollen leg. There may be tenderness and induration along the course of the femoral vessels. This condition is sometimes called 'Phlegmasia alba dolens'. The symptoms subside with treatment. The œdema may, however, in some cases, persist, as also constant pain.

Suppurative Thrombophlebitis. Suppurative thrombophlebitis occurs primarily in the pelvis and occasionally extends into the thigh. It is a cause of pyæmic abscess, particularly in the lung. The clinical picture is characteristic with repeated rigors, high swinging temperature, high pulse rate, severe toxæmia and metastatic abscesses. On vaginal examination tender thrombosed veins may or may not be palpable.

Treatment. Prevention consists in adequate treatment of any factor which favours thrombosis, namely anæmia, trauma and sepsis. Exercises, in early puerperium, are said to be beneficial.

When venous thrombosis has set in, immobilisation of the affected leg is no longer necessary. Antibiotics are administered to minimise infection and anticoagulants to prevent further clot formation. The patient is confined to bed with a cradle over the leg to prevent pressure from bed clothes. The foot of the bed could be elevated to increase the venous flow from the legs. It is now recommended that physiotherapy, starting with passive movements, be started as soon as the diagnosis is established. When afebrile, the patient is encouraged to walk about with the affected leg supported by an elastic bandage.

Anticoagulant Therapy. Heparin is given intravenously in an initial dose of 15,000 international units and its administration is continued by intermittent injection of 7500-10,000 units six-hourly or by a continuous intravenous drip of 15,000 units in a litre of 5 per cent glucose or normal saline at a rate of seventy drops a minute. The object is to maintain a blood clotting time of fifteen to twenty minutes. The clotting time is determined by the Lee-White method. The antidote to Heparin is an intravenous injection of 10 ml. of 1 per cent Protamine Sulphate which will restore normal coagulation. Along with Heparin an oral anticoagulant is also given. Once immediate control by Heparin is obtained, which is usually within twenty-four to forty-eight hours, oral anticoagulants only are employed. Tromexan is more commonly employed. The initial dose is 0.3 gm. tablet by mouth, four-hourly on the first day, followed by 0.3-0.6 gm. daily in divided doses sufficient to keep the Prothrombin level at 20-30 per cent of its normal value. 'Dindevan', a cheaper oral anticoagulant, has been recently introduced. The dosage is 100 mg. on the first day, followed by 50-100 mg. daily, as determined by prothrombin time. Anticoagulants should be discontinued when the prothrombin time rises above forty-five seconds.

When pulmonary embolism occurs, antibiotics and anticoagulant therapy should be started at once. For pain, morphia, and for respiratory distress, oxygen should be given.

Lumbar Sympathetic Ganglion Block. Reflexes arising in the affected venous segment cause reflex spasm in the homolateral arteries and vessels. By anæsthetising the lumbar sympathetic ganglia and chain, the reflex arc can be broken which relieves the pain and promotes vasodilatation in the affected leg. The cold swollen leg becomes warm and the pain is relieved as a result of the relief of vasospasm. The technique is to inject 5 ml. of 1 per cent Procaine hydrochloride through each of four-needle punctures aimed at blocking each lumbar ganglion. It causes dramatic relief in cases with vasospasm. The immediate relief of pain and the prompt subsidence of fever, as well as the decrease in the size of the swollen limb, are said to be spectacular.

When patients fail to respond to general and antibiotic management, especially in suppurative thrombophlebitis, ligation of the thrombotic veins may be indicated.

Cerebral Venous Thrombosis. This is not an uncommon condition. The pregnancy and labour in most cases are normal. The time of onset varies between fourth and twentieth day after delivery. Premonitory symptoms are usually absent. The first symptom may be sudden onset of coma or fits. The fits may be frequent and with increasing fits the coma deepens. The remaining symptoms depend on the site of the thrombosis. If the motor cortex is involved, as often it is, there is complete paralysis of one limb and weakness of the rest of the body. The cerebrospinal fluid is usually normal but may contain a little blood.

The condition has often been mistaken for post-partum eclampsia. Pre-eclamptic toxæmia in the form of high blood pressure, œdema and albuminuria are invariably present in post-partum eclamptics and it is not common for post-partum eclampsia to occur after forty-eight hours.

The treatment is to prevent further thrombosis by anticoagulant therapy, control of convulsions by sedatives and keeping up the general strength by supportive treatment. Physiotherapy for paralysed muscles will be required.

Mastitis and Breast Abscess

Acute mastitis in the puerperium is usually due to staphylococcus aureus. Infection may enter the breast through a cracked nipple, but occasionally the infant may harbour staphylococci in its nasopharynx and infection occurs along the milk ducts. This latter form may sometimes assume epidemic forms in hospital practice.

Types of Mastitis. The infection may be limited to the areola forming an abscess around the nipple. It may involve the lactiferous tubules when it is called parenchymatous or glandular mastitis. The bacteria may gain access to the connective tissue through a crack or deep fissure, burrow into the fat around the lobes and lobules and cause interstitial mastitis. This cellulitis may be superficial or deep. The infection may pass directly through the gland to the areolar tissue under it and produce a submammary abscess.

Symptoms. The parenchymatous form is the most common and is seldom seen before the seventh day of delivery; commonly it occurs between the tenth and twentieth day. Pain, slight fever and sometimes chills are present. The affected lobe is red and tender. One or more lumps may be palpated on the breast. Suppuration usually sets in, if fever continues for more than forty-eight hours. Remittent temperature and chills, along with the affected portion becoming hard, tender and enlarged are indicative of pus formation. Softening and redness of the skin at one point indicate where the abscess is pointing. Unless properly treated, successive lobes may be involved until the whole breast is riddled with abscesses.

In the cellular variety the infection spreads into the gland from a fissure. A fan-shaped redness may be seen spreading from the crack. The deeper lymphatic glands may be involved. Suppuration is much more common in this form.

In sub-mammary abscess the pus collects behind the gland and œdema appears at the periphery. The patient is more toxic and unless the pus is evacuated promptly it may burrow deeply and the patient may die of bacteriæmia.

Treatment. Acute mastitis usually responds to systemic tetracycline 250 mgs. four times daily combined with suppression of lactation and expression of the milk.

If an abscess forms, it must be incised as soon as it is diagnosed. Sometimes the abscess cavity can be emptied by aspiration with a syringe with a wide bore needle. Penicillin should then be injected into the abscess cavity—500,000 units per ml. and enough should be instilled to fill the abscess cavity. These aspirations and injections are repeated every other day till no more pus is aspirated. Some patients can be cured by this simple procedure. The rest require incision and drainage.

One should not wait for the appearance of fluctuation before opening an abscess, as in some cases a great deal of the breast substance is destroyed before any distinct fluctuation can be appreciated. Per-

sistent œdema under such circumstances is quite a sufficient indication to warrant operation. In the supra-mammary variety, it matters little in which direction the incision is made, since the pus is always superficial to the breast tissue. In the true intra-mammary abscess, the incisions should radiate from the nipple. One or more may be needed and these should be freely made so as to allow of the insertion of a finger to open up any pockets or lobules which are distended with suppurating material. A drainage tube is inserted for a time and gradually shortened. When the chief incision is needed above the nipple, it is wise to make a counter-opening in the lower half of the breast and generally on the outer side to permit of efficient drainage. A sub-mammary abscess is best opened towards the lower and outer quadrant and also at any spot where pus points.

Post-partum Pituitary Necrosis. This rare condition may follow delivery in cases in which there has been severe post-partum hæmorrhage with a marked fall in blood pressure. Thrombosis occurs in blood vessels supplying the anterior lobe of the pituitary gland and this is followed by ischæmic necrosis of the whole of the lobe. A thin rim of tissue may however then survive at the periphery of the gland.

In the most severe cases, death occurs soon after delivery. In other cases the patient survives to develop the typical clinical picture of hypopituitarism described by Simmonds as 'Pituitary cachexia'. Sheehan who studied the cases following delivery has contributed largely to the pathogenesis of the lesion (Sheehan's syndrome).

Clinically the first incidence may be complete failure of lactation due to lack of lactogenic hormone but this is followed by symptoms due to lack of thyrotrophic, corticotrophic and gonadotrophic hormones. The patient is lethargic, with anorexia and abnormal sensitivity to cold. She may gain weight and her basal metabolic rate is reduced with an increased glucose tolerance. Genital atrophy occurs with amenorrhœa due to super-involution of the uterus. There is also atrophy of the breasts and loss of pubic and axillary hair. Anæmia similar to that seen in myxœdema may occur.

Treatment. It is essential to treat collapse due to hæmorrhage promptly in order to prevent this complication. When necrosis has occurred treatment with thyroid and suprarenal cortical hormones may be tried. Results are however disappointing.

SECTION X

MISCELLANEOUS

CHAPTER LVIII

PERINATAL MORTALITY

THE terms still-birth and neonatal death, though commonly in use, have been replaced by the term 'perinatal mortality'. It is defined as mortality among foetuses or infants that weigh over 1000 grams at birth, who die before delivery or before the end of the first week of extra-uterine life.

From hospital records it is observed that the average perinatal mortality in India ranges from 60-78 per 1000 births. Perinatal death rate is lowest in the 2nd-4th pregnancies (both inclusive)—36.5 per 1000. It is highest for the first pregnancy 80/1000. It rises to 72/1000 in the fifth pregnancy and over. The sex ratio male : female is 60 : 40. Socio-economic standards of a nation play a very important role in the incidence of perinatal mortality. More than 80% of the population belong to the poor socio-economic group and 70% of perinatal deaths occur in this group.

Many factors influence the likelihood of the embryo or foetus surviving and being born alive. Genetic defects in the germ cell may make continued survival and normal development unlikely or even impossible. Abnormal uterine environment may be brought about by organic disease or by failure of the hormonal and hypothalamic control to keep the uterus quiescent until full maturity of the foetus is reached. Inadequate or improperly balanced diet for the mother during pregnancy or other socio-economic factors may impede the proper growth and normal development of the baby. Systemic disease may adversely influence an otherwise normal gestation.

Various maternal complications in pregnancy and foetal factors contribute to perinatal loss. The clinical causes leading to perinatal death is given below.

Clinical causes of perinatal deaths (8877 cases).

Clinical causes	Mature babies	Premature (2500 G)	Total	Incidence %
Trauma and stress of labour ..	1702	982	2684	30.3
Toxæmia ..	293	1267	1560	17.6
Antepartum Hæmorrhage ..	320	1110	1430	16.2
Maternal disease ..	112	503	615	6.6
Congenital anomalies ..	164	210	374	4.3
Infection ..	49	56	105	1.2
Undetermined ..	376	1733	2109	23.8
	3016	5861	8877	100.0

The most critical period for the baby is labour and delivery. Many complications can and do arise which have a fatal effect on the child most often by either anoxia or intra-cranial injury. Anoxia may result from cord compression or premature separation of the normal or abnormal placenta. Prolonged labour and abnormal uterine action may give rise to anoxia. Intra-cranial injury may result from spontaneous or more often operative delivery.

Anoxia. Anoxia is the result of interference with the transport of oxygen from maternal blood to the foetal blood in the placenta or obstruction in the flow through the umbilical cord. There are many causes of anoxia during pregnancy, labour and delivery. Among these premature separation of the placenta and prolapse of the cord and compression are the most common causes. Placenta prævia also may cause anoxia. Abnormally long labour, especially prolonged second stage, leads to an increase in danger of anoxia from continued compression of the head resulting in circulatory changes. The longer a patient is allowed in labour, the greater the likelihood of foetal death. Undue delay in the delivery of the after-coming head in a breech presentation, or delay occasionally encountered in extracting the shoulders of a very large foetus, may also cause death. Sudden lowering of maternal blood pressure, as in shock or some cases of spinal anæsthesia, may result in anoxia. More commonly the oxygen saturation of the maternal blood is reduced by certain varieties of inhalation anæsthesia, especially nitrous oxide. The injudicious use of analgesic drugs may interfere with the establishment of normal breathing by depressing the respiratory centre at a time when it needs to be most

active. Other conditions have been thought possible to contribute to foetal anoxia, although their exact role is difficult to prove. It has been said that hypertension or renal disease may affect the vessels in the placental site and consequently prevent proper placental oxygenation. It is also said that placental changes occur in post-maturity due to prolonged pregnancy resulting in anoxia which may be detrimental to the foetus.

Birth Injury. To the obstetrician death from birth trauma has always been the most obvious and important cause of still-birth because its prevention depends largely on the standard of maternity service and the skill of the attendant. Various types of birth trauma which may prove fatal may occur during delivery. Intra-cranial injury and hæmorrhage result from any condition that causes excessive stress during labour—such as cephalopelvic disproportion, difficult forceps, too rapid delivery of the after-coming head, etc. The premature foetus is more vulnerable and it is not uncommon to see such injury even after a normal spontaneous labour. The common type found is subdural hæmorrhage resulting from the rupture of the vein of Galen; but any of the cerebral veins may give way. Congestion and œdema of the brain and meninges may also result from prolonged compression of the head. Extradural, subarachnoid and intraventricular hæmorrhage may also be found occasionally. Injuries to the spine are occasionally encountered in cases of breech delivery and impacted shoulders. Rarely injuries to the viscera are seen. Death may not be most serious consequence of birth trauma. More important may be the brain damage that results in an abnormal child. Often subtle damage little manifest at birth may not make itself known until the child is a year or more old or when it begins to go to school.

Malformation. Malformations incompatible with life have been the subject of intensive study in recent years. Viruses as causative agents have received some attention since German measles in the early weeks of gestation have been shown to result at times in abnormalities of the foetus. The localisation of the congenital anomaly and its extent are determined in a large measure by the developmental stage of the embryo at the time of the maternal infection. The likelihood of damage of the embryo is minimal if the disease occurs after ten weeks of gestation. There are many other causes of congenital malformations besides virus infections. Inherited genetic defects, environmental factors that interfere with the healthy implantation of the fertilised ovum and its subsequent development are without doubt causes of early abortion and may be responsible for alteration in growth leading to malformation. Maternal radiation is receiving a great deal of attention at the present time. Attention is also being focussed on congenital malformations resulting from the use of progestational and androgenic

steroids in early pregnancy for repeated abortion. In our study congenital malformation incompatible with life was present in 7% of perinatal deaths.

Pulmonary Complications. In order to survive, an infant must breathe adequately immediately after birth which does happen in all normal and sufficiently mature babies. Unless the alveoli in the lungs are sufficiently well developed to permit adequate oxygenation of the blood, continued survival is not possible and respiration will cease within a short time. If an infant fails to inspire immediately after birth it is because of injury to the respiratory centre by (1) anoxia, (2) intracranial injury, (3) depression by drugs, (4) obstruction in upper respiratory passages, (5) debris from amniotic fluid filling the alveoli due to intra-uterine aspiration and thus preventing expansion, (6) massive diaphragmatic hernia also prevents proper expansion of lungs, (7) non-vascularised and hypoplastic lungs. The inhibition of respiration at birth may be temporary or permanent depending on the cause and severity. It is also possible for evidence of damage to be delayed and the child may breathe at birth only to develop respiratory difficulty a few hours later. One special variety of pulmonary disturbance has been called 'hyaline membrane with resorption atelectasis'. This condition is much more common in premature than in term infants and also more commonly seen in babies delivered by cæsarean section. The condition is easily recognised on post-mortem examination. Microscopic examination of the lungs shows almost complete atelectasis with a homogeneous pink staining material forming a lining on the inner surface of the alveolar ducts.

Pulmonary hæmorrhage—massive pulmonary hæmorrhage—has been found in post-mortem studies on perinatal deaths as a major pulmonary lesion more commonly than pulmonary hyaline membrane.

Pneumonia. Pulmonary infections may occur intrapartum or in the neonatal period. They are less amenable to control since most of those responsible for perinatal death have an intra-uterine origin. Early rupture of the membranes will allow organisms from the lower genital tract to invade the amniotic cavity and the longer the membranes have been ruptured prior to delivery, the greater is the likelihood of pulmonary infection. Prolonged labour is often accompanied by frequent vaginal examinations and often terminated by difficult delivery both of which increase the hazard of infection in the new-born.

The foetal surface of the placenta may be infected by bacteria gaining entrance to the amniotic sac and infected fluid aspirated into the foetal lungs is responsible for pulmonary infection.

Hæmolytic Disease. The frequency of deaths from erythroblastosis among total births depends partly on the management of the immunised Rh-negative woman and the treatment of an affected infant. There are great variations in the incidence of the disease itself. The differences are geographical and racial. The incidence of erythroblastosis is far less than in Western countries. However, it is one of the factors to be taken into consideration in the reduction of perinatal mortality.

Prematurity. A baby weighing less than $5\frac{1}{2}$ pounds (2500 gms.) at birth is classed as premature according to international standards. If this standard is adopted nearly 25%-30% of babies, though born at term, are premature by weight. Since the definition of perinatal mortality is confined to babies weighing more than 1000 gms. at birth, few deaths can be attributed *per se* to prematurity. Nevertheless, in any perinatal death survey the highest incidence of deaths will be found in the weight group 1000 gms.-2500 gms. It shows that the weight of a baby is a very important factor in determining whether it will survive. In our study of perinatal deaths 64% of babies weighed less than 2500 grams. Maternal complications were evident in over 60% of premature births. The common ones encountered are placenta prævia, abruptio placenta, toxæmias of pregnancy, anæmia and malnutrition and multiple pregnancy. Prematurity is more common in the multigravida. The maternal factors associated with prematurity in our study of perinatal deaths are given below :—

Maternal factors	Percentage
Ante-partum Hæmorrhage	... 25.4
Toxæmias of pregnancy	... 21.8
Acute illness	... 19.6
Multiple pregnancy	... 8.4
Hydramnios	... 7.1
Cause unknown	... 17.7

Post-maturity. Post-maturity as a cause of foetal and neonatal deaths has been brought to light in recent publications. Although the length of gestation is said to be 280 days, it varies considerably in different women and in the several pregnancies in the same woman. Controversial evidence has been presented regarding the incidence of anoxia in a post-mature infant.

Autopsy studies are essential for a basic understanding of problems involved in perinatal deaths. The findings in 1900 autopsies giving the main cause of death with its incidence are given below.

Causes of Perinatal loss as found at autopsy in 1900 cases.

Fœtal pathology	No. of cases	Incidence %
Anoxia	596	31.6
Birth injury	375	19.7
Congenital malformation	165	8.7
Pneumonia	257	13.5
Pulmonary hæmorrhage	46	2.3
Hyaline membrane	63	3.2
Blood dyscrasias	17	0.9
Maceration	131	6.9
Other ill-defined or unknown cases	250	13.1

Classification based primarily on findings at autopsy is unsatisfactory both in theory and practice. To take into account all the clinical circumstances as well as the pathological findings is sounder, provided full case records are available. Table below gives a clinico-pathological co-relation in 1000 cases.

*Clinico-pathological co-relation of perinatal loss in 1000 cases.**Clinical (maternal, obstetric and fœtal) causes*

Fœtal pathology	Trauma & stress of labour	Toxæmia	Maternal diseases	Antepartum hæmorrhage	Infection & others	Cause unknown	Total	%
Anoxia	163	56	11	77	18	24	349	34.9
Birth injuries	132	6	1	7	1	10	157	15.7
Congenital malformation	2	1	—	1	—	96	100	10.0
Pneumonia	34	15	9	3	20	37	118	11.8
Massive pulmonary hæmorrhage	11	9	7	5	5	7	44	4.4
Hyaline membrane	2	1	4	5	5	3	20	2.0
Infections	—	1	16	1	9	4	31	3.1
Blood dyscrasias	—	1	3	1	—	8	13	1.3
Maceration	33	33	21	15	8	21	131	13.1
Unknown	2	1	6	—	—	28	37	3.7
	379	124	78	115	66	238	1000	100.0

Many factors other than those that have been discussed influence perinatal mortality. Pregnancies towards the closing stages of

reproductive activity result in increased perinatal mortality. Perinatal mortality increases after the 4th pregnancy. Prevention of conception after the 3rd or 4th pregnancy will help to reduce its incidence further.

Evidence obtained from limited clinical and pathological studies indicates that the main problems to be tackled in further reducing perinatal mortality are: (1) Maintenance of correct vital statistics; (2) Improvements of socio-economic standards; (3) Providing of efficient obstetric and pædiatric service; (4) Education of the public to utilise such services; (5) Prevention, control and efficient treatment of diseases complicating pregnancy; (6) Continued study of perinatal mortality problems by demographic, clinical and pathological research.

MATERNAL MORTALITY

No health problem can be of greater consequence to a nation than maternal and infant welfare. The standard of Obstetric service in a country is assessed by its maternal and perinatal death rates. For such an assessment the first essential is a proper and correct registration of all births and deaths. In technically advanced countries such data with causes of death as ascertained by post-mortem would be available with the Registrar-General or his counterpart. In India also registration of births and deaths is compulsory but its enforcement leaves much to be desired. Added to it there is the extreme difficulty of obtaining post-mortem examinations. All these facts tend to diminish the accuracy of available data.

A maternal death may be defined as the death of any woman dying of any cause whatsoever while pregnant or within 90 days according to some or within one year according to others of the termination of pregnancy irrespective of the duration of pregnancy at the time of termination or the method by which it was terminated. These usually consist of deaths from causes assigned in 'International classification of diseases—Code Nos. 640-689—complications of pregnancy, child birth and puerperium'. The maternal mortality rate is usually expressed as the number of deaths per 1000 total births—some express it per 10,000 total births. It should always be stated whether abortions have been included or not.

The causes of maternal death may again be classified into two—namely those due to direct obstetric causes and those due to associated conditions. Deaths due to direct obstetric causes are those wherein death has occurred as a direct result of complications of pregnancy, parturition or puerperium. On the other hand if a pregnant woman dies due to diseases which do not result from the pregnant state—as for example small-pox, infective hepatitis, heart disease, anæmia—such a death while classified as a maternal death should be shown as death due to associated causes. Such a classification helps the obstetrician in further assessing the standards of obstetric service and to judge whether a maternal death was preventible or unavoidable.

Many factors influence maternal mortality. It is a well-known fact that maternal mortality increases with increasing age and parity. Mortality is lowest in the second, and third deliveries and shows a

significant rise after the fifth. In fact the greater the parity after five the greater the mortality. That is not only due to obstetric factors but also because diseases like hypertension, renal, vascular and other diseases like diabetes, complicate pregnancy as age advances.

Socio-economic standards influence significantly the maternal health. In developed areas of the world with high socio-economic levels maternal mortality has been reduced to very negligible proportions. Malnutrition, anæmia, infectious diseases and other allied conditions seldom complicate a pregnancy in these countries while they are still rampant in developing areas of the world contributing significantly to maternal mortality.

Efficient antenatal and intranatal care, availability of such care to the vast majority if not to all pregnant women, highly specialised care being made available to all who require it—have contributed greatly in those countries in improving significantly the mortality rates. On the other hand in the developing regions, efficient antenatal care is available to only a fraction of those who need it. Specialised care is available to only a few and more than 50% of pregnant mothers have no skilled attention of any sort—neither from medical or para-medical personnel. In most of the developed areas of the world majority of the deliveries take place in well equipped hospitals. In some excellent domiciliary service is provided with close integration of the domiciliary and hospital services. Such an integration results in an excellent obstetric service. In the developing areas on the other hand, hospital facilities cannot meet a fraction of the requirements, domiciliary services are not properly organised and there is no integration between domiciliary and hospital services. The maternal mortality rates therefore continue to be high. Blood transfusion services and transport facilities are extremely important for both hospital and domiciliary services. It is needless to state that well trained doctors, nurses and midwives form the backbone of any efficient obstetric service and all these factors along with the education of the public to utilise such services influence the maternal mortality rate.

During the last three decades monumental changes have taken place in medicine. These years saw the birth of chemotherapy, and antibiotics, establishment of blood transfusion services, improvements in anæsthesia and surgical techniques and harnessing of atoms into medicine. The impact of such advances has been significant in all fields of medicine including obstetrics and this is reflected in the reduction of the maternal mortality rate. The figures which will be briefly presented refer only to the government hospital for women and children, Madras.

Prior to the era of chemotherapy and antibiotics during 1929-1940 the maternal death rate in 43,658 deliveries was 19 per 1000 while in

1962-1965 among 71,893 deliveries it had dropped to 5.9 per 1000. A reduction of 66% has thus been achieved. The table below gives the maternal death rate in the hospital during a four-year period.

Year	Total No. of deliveries including abortions	No. of deaths & mortality rate per 1000	No. of deliveries after 28 weeks	No. of deaths & mortality rate per 1000	No. of abortions	No. of deaths & mortality rate per 1000
1962-65	71,893	427 (5.9)	61,611	384 (6.2)	10,282	43 (4.1)

As stated previously it is customary to divide the total deaths into those due to direct obstetric causes and those due to associated causes. The table below shows the percentage of deaths in each group so classified.

Year	Total No. of deaths	No. due to direct Obstetric causes	% of all deaths	No. due to associated causes	% of all deaths
1962-1965	427	231	54%	196	46%

Rearranging and regrouping according to the International Code gives the following distribution:—

	Abortion with or without sepsis Code 650-652	Toxæmia Code 642, 685, 686	Hæmorrhage Code 643, 644, 670, 671, 672	Sepsis Code 640, 641, 680, 684	Others Remainder 640-689	Total
No. of cases	43	29	60	32	263	42%
Rate per 1000	0.6	0.4	0.8	0.5	3.6	..
% of all deaths	10	7	14	7	62	100

During the years prior to the era of antibiotics and blood transfusion, puerperal infection, hæmorrhages, eclampsia and accidents of labour accounted for nearly 75% of all deaths. Majority of deaths were thus due to direct obstetric causes. Deaths from infection were the highest, closely followed by that due to hæmorrhages, toxæmias of pregnancy and accidents of labour. With improvements in obstetric service and availability of modern facilities a significant reduction in deaths from direct obstetric causes became noticeable. This reduction was most marked in deaths from infection. At present,

hæmorrhage occupies the first place in deaths due to direct obstetric causes.

Hæmorrhages. During the four years 1962-1965 hæmorrhage accounted for 14% of all maternal deaths and 26% of deaths due to direct obstetric causes.

Accidental hæmorrhage and placenta prævia are the commonest causes of antepartum hæmorrhage. The extended use of cæsarean section in placenta prævia rendered possible by the availability of blood transfusion and antibiotics has reduced the maternal mortality due to this condition considerably. The table below gives a comparative statement of the management and mortality rate in placenta prævia prior to and after the availability of modern facilities.

Period	No. of cases of placenta prævia	Cæsarean section rate %	Maternal mortality rate %
1929-1940	319	10.3	16.6
1954-1965	724	56.2	2.2

The mortality rate in placenta prævia has dropped from 16.6% to 2.2% mainly as a result of availability of blood transfusion and the extended use of cæsarean section. However, it has not been possible to reduce significantly deaths from premature separation of the placenta. The pathogenesis of this condition is not clear and fatal complications like renal failure, and coagulation failure in the severe varieties are much more common than in placenta prævia.

Post-partum hæmorrhage and retained placenta accounted for a large percentage of deaths in the earlier years. In those years powerful oxytocics which are in use at present were not available. Manual removal of placenta was a dreaded operation because of the fear of infection and shock. Today it is a different tale. Powerful oxytocics are available to combat uterine atony and hæmorrhage. Shock is combatted by blood transfusion and infection controlled by antibiotics. In 1965, of 115 maternal deaths four were from post-partum hæmorrhage an incidence of 3.5%. Of these four deaths three occurred in patients brought in after having delivered outside and almost moribund with hæmorrhage. These are of course preventible.

The modern dictum is that no patient should die of hæmorrhage. With properly organised obstetric service this ideal could be almost achieved. All patients, with ante-partum hæmorrhage should be delivered only in well equipped hospitals, likewise all pregnant mothers

who are likely to develop post-partum hæmorrhage. If on a domiciliary service post-partum hæmorrhage occurs a flying squad with all facilities for treatment of shock and hæmorrhage should be available to render resuscitation. Such facilities will help to prevent deaths from hæmorrhage.

Toxæmia. Deaths from toxæmia have been significantly reduced. This has been achieved mainly by the modified treatment of eclampsia adopted since 1958. Prior to that the mortality rate in 1959 cases of eclampsia was 15.9%. Since 1958 even though the incidence or severity of the disease has not diminished the maternal mortality rate in 1448 of eclampsia was only 2.4%. This result has been achieved by scrupulously following the schedule laid down for the treatment of eclampsia described in that chapter. In the last four years deaths from toxæmia accounted for 7% of all maternal deaths and 12% of deaths due to direct obstetric causes. Proper antenatal supervision should prevent eclampsia and where such supervision is not available or inadequate only proper curative treatment can improve the mortality rate.

Puerperal sepsis. Prior to the era of antibiotics 25% of all maternal deaths was from puerperal infection. Since the advent of chemotherapy and antibiotics the deaths from infection have dropped to 7% of all deaths and 14% of deaths from direct obstetric causes.

Abortions. It is difficult to estimate the actual incidence of abortions or death rate. For one thing abortions need not be registered and secondly criminal abortions wherein most deaths occur are seldom registered as such. All that can be stated is that while deaths from puerperal infections have been significantly reduced, those from abortions with infection have not fallen correspondingly. Larger number of deaths from infection are now from abortions.

Others. This is a miscellaneous group. Many deaths in this category are from avoidable factors. Perhaps accidents of labour form the largest group in this category. Reference will be made to one particular factor namely rupture of the uterus. Obstructed labour and grand multiparity are the common causes. Proper antenatal and intranatal care will help to reduce it to the minimum. In modern obstetrics one faces the problem of rupture of a cæsarean scar in a subsequent pregnancy as more and more cæsarean sections are being done. Here again avoidance of classical section, proper assessment of all factors to decide the management in a subsequent pregnancy and always a hospital delivery after a previous cæsarean section will help to reduce the incidence of scar rupture. In developing countries with paucity of antenatal care and ignorance or unwillingness on the

part of the pregnant mothers to attend hospitals early, rupture of the uterus still constitutes a serious problem. However one can find consolation in the fact that while methods of prevention lie beyond the capacity of the obstetrician alone, with modern facilities in the management of these cases the mortality rate has been considerably reduced. Where the mortality rate was 75% during the year 1929-1940, in the year 1962-65 the mortality rate for rupture of the uterus was only 10.3%. Here again emphasis should be on prevention.

Associated causes. In developing countries many diseases may complicate pregnancy making pregnancy more hazardous. In fact it is quite common to find large number of pregnant women suffering from diseases like anæmia, tuberculosis, infective hepatitis, cardiac diseases, acute infectious diseases, gastro-intestinal diseases and malnutrition. Such patients also develop complications of pregnancy like pre-eclamptic toxæmia, ante-partum hæmorrhage. Often it becomes difficult to decide the primary cause of death, as there are multiple factors involved.

Of all these diseases anæmia in pregnancy accounts for 25% of deaths due to associated causes and 11.5% of all maternal deaths. Heart disease in pregnancy accounted for 8.2% of all deaths and 18% of deaths due to associated causes. Infective hepatitis, especially when it occurs in epidemics, is associated with high mortality, so also smallpox when it complicates pregnancy. Until a decade ago malaria constituted a grave threat in pregnancy but now thanks to the eradication measures adopted it is no longer so. Malnutrition is very common and it enhances considerably the hazards in pregnancy. It is obvious most of these deaths are preventible.

From this brief survey it will be observed that while maternal mortality has been considerably reduced it could be reduced still further as many of the deaths are preventible and this can be done only by major improvements in socio-economic standards, education of the population and establishment of a proper obstetric service available to all. This is a vast problem but it has to be solved.

In the well developed areas of the world great progress has been made in the preventive and operative aspects of obstetrics and gynæcology. In these areas maternal mortality has almost disappeared and perinatal loss rates not only have declined sharply but continue to do so. In our country the applications to all groups of the population the existing knowledge and the best level of care to groups of the population would itself produce a very pronounced fall in rates of death and disease and a positive gain in the health of the women. Obstetricians have become increasingly aware of the way in which

their patients, the maternity services and their efficiency are affected by the broader society and how the health and happiness of families are affected by their techniques and the whole approach for the running of the services.

Many aspects of personal and community life have an effect on child bearing potential. Women from rural and urban areas from different regions in the same country enter child birth with different obstetric risks. Reproductive efficiency is therefore influenced by factors outside the control of the obstetrician and the selection of the most appropriate group of the population for specialist and hospital care is of the utmost importance. Faced with a great dearth of specialists, doctors, nurses, midwives and health visitors it is very necessary for us to make a rational selection and identify these groups with the highest child bearing risk so that appropriate methods of treatment could be applied to such groups. In developing countries with limited obstetric and financial resources such a policy of rational selection is the best way to make use of limited means and reduce maternal mortality further.

With the very limited resources at present available it would be essential if existing facilities are to be utilised to the fullest benefit to the community to restrict institutional deliveries under specialist care to the 'Risk' cases. Domiciliary midwifery has to play an important role and it should be strengthened by the addition of more and better trained personnel-doctors, nurses, midwives, health visitors, social service and other ancillary personnel. In addition there should be integration of the domiciliary and institutional services. Then only will the existing facilities yield better results and maternal mortality further reduced.

POST-MATURITY

THE duration of pregnancy is not definite and precise. Using the time-honoured standard Nægele's rule in the determination of the expected date of confinement (EDC) it is said to be 280 days or forty weeks. Using this criterion it is found that 10 to 12% of pregnancies extend to or beyond 294 days, while roughly 4% extend to 301 days or more in total duration from the first day of the last menstrual period. Doubt however has been cast upon these data by recent work whereby the length of gestation has been calculated following artificial insemination or with the use of basal temperature charts to determine the time of ovulation. In the former instance the average duration of pregnancy is 272 days (261 to 288), while in the latter it is 266 to 270 days. In some of these cases the pregnancy would have lasted 349 days if computed on menstrual data alone. In such instances the long gestations were attributed to delayed ovulation and subsequent fertilisation. Also, women who menstruate at shorter intervals than 28 days may expect their confinement earlier than those with longer cycles.

The usual criteria employed for estimating maturity—calculation from the menstrual data, growth of uterus, date of quickening, size of foetus—are very unsatisfactory because of significant percentage of error. Of late more reliable methods of estimating maturity of the foetus have been described.

Cytological Examination of Amniotic Fluid. A method for estimating foetal maturity by cytological examination of the amniotic fluid has now been established. It is helpful in the assessment of foetal maturity especially in the management of complicated pregnancies. The method is based on the staining of lipid-containing cells in amniotic fluid with Nile Blue sulphate. The lipid containing cells or 'fat cells' which are exfoliated into amniotic fluid originate in the foetal sebaceous glands and the number of fat cells found reflects accurately the development and increasing maturity of the foetus. The technique consists in mixing one or two drops of amniotic fluid obtained by puncture per abdomen on a glass slide with equal amount of 0.1 per cent Nile Blue sulphate solution. The slide is allowed to dry for five minutes at room temperature and 500 cells are then counted and classified.

The 'Fat cells' usually are stained orange to brown either ovoid or polygonal in shape and present in varying numbers depending on

duration of pregnancy. This test is a useful guide to fetal maturity in the last four weeks of pregnancy. A fat cell count of over 10 per cent is met with only when pregnancy is beyond 36 weeks. As pregnancy advances the percentage of fat cells continue to increase, usually reaching to about 20% at 38 weeks. Majority show a count of 50 per cent or more between 39 and 42 weeks. This method is therefore a valuable guide in assessing fetal maturity though not infallible.

Estimation of Creatinine in Liquor Amni. There is evidence to suggest that amniotic fluid in the third trimester is largely a product of the fetal kidneys. This is due to a substantial increase in the number of functional glomeruli and to the proper establishment of tubular function. It is expected therefore that as the fetus matures a substance such as creatinine which is completely filtered at the glomeruli and is not reabsorbed by the tubules will be found in increasing amounts in the amniotic fluid. Amniotic fluid creatinine increases in a linear fashion with advancing pregnancy. The creatinine content of the liquor is always higher than that of maternal serum. Ninety-five per cent of normal patients at or about 37 weeks have a liquor creatinine content of 1.72 ± 0.56 mgs. per 100 ml. and by 41 weeks it is usually 2.74 ± 0.55 mgs. per 100 ml. It is also observed that in most cases where the liquor amni creatinine content is 1.5 mgs. per 100 ml. or more the duration of pregnancy is seldom less than 34 weeks and in 80% with values of 2.2 mgms. or more the duration of gestation is over 38 weeks. This method can therefore be applied antenatally to help estimating fetal maturity.

Many doubt the occurrence of post-maturity. But in spite of strong objections there are however true cases of post-maturity. Cases have been reported of post-maturity or prolonged pregnancy upto 337 days. A special problem noted by many clinicians is the association of prolonged pregnancy with anencephalic fetuses. It is necessary in diagnosing prolonged pregnancy that the fetal heart should have been audible some days after term. Those cases where the fetus dies *in utero* before term and is delivered some weeks after term should not be considered as cases of prolonged pregnancy. It is also found that only about 4% of pregnancies end on the expected date of confinement.

Experimentally, pregnancy can be prolonged beyond the expected date by injection of Progesterone. During prolonged pregnancy characteristic changes are seen in the fetal organs—especially the endocrine organs. These changes are hyperæmia, œdema and regressive cellular changes. They are marked prior to intra-uterine death of the fetus. Hyperæmia is said to be the primary change. Histologically, during prolonged pregnancy, a rapidly developing and severe degeneration of the placenta as a whole could be detected.

Hyalinisation takes place and the placenta becomes small, pale, hyalinised, the amniotic fluid is very scanty and sometimes fœtid. The umbilical cord gets shrunken.

The cause of intra-uterine death during prolonged pregnancy was thought to be due to cessation of placental function towards term. This assumption was supported by the regressive changes occurring in the placenta in the later stages of pregnancy. It has also been found that the Progesterone values in the placenta, in cases of post-maturity, were two to six times higher than normal.

Physiology of Mature and Post-Maturity Pregnancy. Barcroft showed that the blood emerging from the uterine vein of normal pregnant rabbits contains progressively less oxygen upto term when it is reduced to 30 per cent saturation. During the period of post-maturity, oxygen saturation of blood deteriorated progressively with time. The fœtus passed progressively through a period of anoxæmia to death. Because of certain diffusion gradients, fœtal tissue must exist under oxygen pressure, which is approximately one-third that to which the adult blood is exposed in the pulmonary capillaries. According to Eastman the oxygen pressure in the fœtus is about 35 to 40 mm. of Hg. As a consequence, the fœtus exists in a state of cyanosis but manages to live in this environment by several adaptations, the most noteworthy of which is a pronounced increase in hæmoglobin. Because of certain vagaries of uterine contractility and placental behaviour, this meagre supply of oxygen is sometimes depressed even lower than usual and this the fœtus cannot endure for more than a few minutes.

Walker found that at the 30th week of pregnancy the oxygen content in the umbilical vein was 15 vols. per cent, with a saturation of 70 per cent. At the 39th week the oxygen content was reduced to 12 volumes per cent, with a saturation of 60 per cent. At 42 or 43 weeks the venous oxygen content fell rapidly to less than 8 volumes per cent, the saturation being 30 per cent. At this stage, meconium staining of the liquor is usually observed and the fœtus is in distress. When oxygen begins to fail, the fœtus attempts to maintain the content by increasing the oxygen-carrying power of its blood, that is, it produces more hæmoglobin. This attempt at acclimatisation might succeed if the oxygen supply were stable at the new low level but it is only of limited value to the fœtus, as the supply at the source continues to decrease, and the hæmoglobin vainly continues to rise reaching as high as 140 per cent by the 43rd week.

At term the efficiency of the maternal uterine circulation becomes impaired and the efficiency of the placenta begins to wane. The oxygen consumption per unit weight of placenta decreases as the pregnancy advances, the values being lowest in placenta at term. There is a

definite aging of the placenta—histochemical and morphological. The changes in the placenta at term and beyond are :—

- (a) fall in oxygen consumption per unit weight of the placenta.
- (b) Syncytial degeneration and aging of the placenta-syncytial knots.
- (c) Degenerative changes with inter-villous thrombosis, fibrin deposition and syncytial knot formation.
- (d) Decline in the placental transfer rate of sodium as made out by radioactive sodium injection experiments.
- (e) fall in the functional activity of the placenta.

As a result, after term, when placental functions are on the wane, the fœtus gets little nourishment and its rate of growth is diminished.

Numerous conflicting reports concerning the changes in the placenta in prolonged pregnancy are available. The findings are confusing. Reynolds and others however believe that post-mature placentæ show no increased degeneration over mature placentæ.

Clinical Concept of Post-maturity. Williams confined the designation of prolonged pregnancy to cases in which the child weighed at least 4000 grams (8½ lbs.) and history indicated that 11 lunar months have lapsed since the last menstruation. The criterion of post-maturity varied from 285 days to 304 days. Many authors call a fœtus post-mature which is born two weeks or more after the expected date. If this is conceded at least 12 per cent of pregnancies will be post-mature.

In addition to the length of the gestation, other criteria have been employed. They are :—

- (1) Weight 4000 to 4500 grammes or more.
- (2) Length of the fœtus—A minimum of 53 to 56 cms.
- (3) Clinical appearance of the baby at birth—absence of vernix, green coloured amniotic fluid, loss of skin at birth, firm unmoulded fœtal head, greatly enlarged placenta.

There are many who believe that post-maturity is only a 'figment of the imagination'. Eastman believes that the problem of post-maturity is non-existent, so does Wriggley, Holmes and others. On the other hand, Walker and others believe that it is a clinical problem.

Ætiology. So far nothing definite is known about the ætiology. Comfortable surroundings, sedentary life with little or no exercise are said to be conducive to prolonged gestation. It is commonly stated

that elderly primiparæ and multiparæ are more likely to have post-mature children.

Diagnosis. This is even more difficult and often based on doubtful criteria. They are:—

- (a) The abnormal size of the fœtus which can be more easily recognised because of the oligo-hydramnios.
- (b) the rate of growth of the uterus.
- (c) The characteristics of the fœtal skull on palpation.
- (d) the condition of the cervix.
- (e) test induction with oxytocin.

There is disagreement concerning the importance of these diagnostic aids. Post-mature pregnancy often does not respond to oxytocin induction.

(f) Radiography. Presence of ossification centres of the os capitatum and os hamatum is said to be diagnostic of post-maturity. Here too there is difference of opinion. There are some who believe that estimation of the biparietal diameters of the fœtus may help, while others believe that technical visualisation of the distal epiphysis of the femur is more accurate.

Hazards to the Mother and the Child. It is believed that there is a higher perinatal mortality rate in post-mature cases. Intra-uterine death of the fœtus due to anoxia and anoxia in labour are the common causes. Some causes are related to difficult labour and delivery. The average perinatal mortality is about 7.4 per cent.

Management. This depends upon one's views on the subject. Those who do not believe that it is a clinical problem treat it on the same lines as a normal one. The problem of the big child is tackled on the lines of disproportion. Those who believe in post-maturity and the dangers inherent in it believe that no pregnancy should be permitted to continue beyond a fortnight after the due date and in any case not more than three weeks from the expected date. If the patient does not get into labour by then, labour is induced after a careful assessment of the pelvis and disproportion.

Among the hospital class of patients it is very difficult to assess the duration of pregnancy. Very few of them are able to give correctly the date of their last menstrual period and hence in assessing the duration of pregnancy one has to depend heavily on clinical findings.

Once we are convinced that the fœtus has reached term, we induce labour within 10-14 days if the patient has not gone into

labour spontaneously by that time. We are partial to the use of oxytocin drip and artificial rupture of the membranes for this purpose in the absence of any other complications like elderly primiparity, disproportion, toxæmia, etc. We do not resort to elective cæsarean section. If, however, in labour, fœtal distress supervenes, cæsarean section is resorted to, if vaginal delivery cannot be easily effected.

In England, during the last 15 years, the policy of elective induction of labour has been evolved in many clinics. Walker's study on fœtal anoxia has given it a great impetus. Surgical induction is the method usually adopted. There are some who believe that labour need not be induced, but if fœtal distress supervenes at any time after term, cæsarean section may be done. If the cervix is not easily dilatable, induction has its hazards and the hazards from post-maturity *per se* may not be greater than those of surgical induction under such conditions.

PLACENTAL INSUFFICIENCY

THERE are many conditions in the mother in which fœtal death or retardation of its growth may occur in utero. Also in a not insignificant number, these occur from no obvious cause. Failure of placental function is a concept which has been invoked by the obstetrician to explain such fœtal death.

Ætiology. Fœtal death in placental insufficiency is produced by interference with the nutrition and oxygenation of the fœtus. There are many conditions in the mother which may give rise to failure of placental function—The important ones are (1) Pre-eclamptic toxæmia (2) Hypertension (3) Chronic renal disease (4) Post-maturity (5) Diabetes (6) Ante-partum hæmorrhage (7) Multiple pregnancy (8) Rh-incompatibility and lastly there is a group wherein no ætiological factors are obvious.

An examination of the placenta after delivery usually shows characteristic changes depending mainly on the ætiological factor concerned. Commonly the placenta is smaller in size than normal, its maternal surface is often full of infarcts and microscopically it may show the characteristic changes of premature aging. Medial thickening of the blood vessels in the villous stalks and deposition of collagen in the villous stroma may be observed. In essential hypertension medial thickening and endarterial proliferation with obliteration of the lumen of the blood vessels can be seen. The decidua also may show changes—decidual hæmorrhages, intervillous blood clots and thrombosis in decidual vessels may be seen in cases where the ætiological factor is accidental hæmorrhage.

Clinical aspects. Clinically the obstetrician should always bear in mind the possibility of failure of placental function in all cases with the previously enumerated maternal complications in pregnancy. The one obvious clinical sign is the failure of the fœtus to grow as the pregnancy advances. The uterus is smaller than the corresponding period of amenorrhœa. This is due not only to the small size of the fœtus but also due to very scanty or no liquor amnii which is often found in association. The fœtus is very much under-weight due to poor nutrition. At birth it is often small, with wrinkled dry, meconium stained skin and if alive it may die early in the neonatal period from respiratory distress. There is however a group of cases where

in spite of placental insufficiency the babies may be larger and heavier. To this group belongs some cases of post-maturity and diabetes complicating pregnancy. The placenta is also larger and heavier in this group but functionally it is at fault.

It has been suggested that static or decreasing maternal weight or abdominal girth in late pregnancy are clinical signs of placental insufficiency. This suggestion has been applied both to the relatively acute type of placental insufficiency which leads to intra-partum asphyxia in post-maturity and to chronic placental insufficiency during the third trimester characterised by retarded intra-uterine growth and leading to the birth of a dysmature baby which may die in the neonatal period.

The problem facing the obstetrician is to assess the state of the foetus and induce labour in time and save it from not only intra-uterine death but also from early neonatal death. For this purpose various tests have been devised—some of the important ones will be discussed briefly.

(1) *Vaginal cytology*—over the past three decades frequent reports have appeared concerning the value of exfoliative vaginal cytology as an index of endocrine function. These investigations have shown that it may be a diagnostic and prognostic technique to evaluate the status of pregnancy. After conception the luteal cytologic picture described by Papanicolou usually persists for two or three more weeks. The eosinophilic index (obtained by determining the percentage of acidophilic cells in a vaginal smear) usually remains under ten in a normal pregnancy. A tendency for increase in the eosinophilic index in the first trimester especially may indicate a failure of corpus luteum before adequate placental production of progesterone. Increasing eosinophilic index along with certain other changes in the vaginal cytogram is said to be an indication of placental insufficiency. Opinions are however divided on the point. The vaginal smear in all stages of normal and abnormal pregnancies have been described. The trained cytologist can recognise three types of smears—(1) normal pregnancy or pre-term smear (2) term smear (3) post-mature smear. A term smear if seen usually indicates that labour is imminent and when seen some weeks before term may indicate onset of premature labour. Provided the vaginal smear is a normal one, the foetus may be said to be in no danger but if a post-mature smear is obtained it denotes failing placental function and impending death of the foetus. There are however many difficulties and fallacies in the interpretation of the smear.

(2) *Oestriol estimation in Urine*. Many investigators have confirmed the fact that measurement of the rate of maternal urinary oestriol

excretion is a reliable index for the assessment of placental function and the state of the foetus. The oestrogenic activity of blood and urine during the course of pregnancy especially after the 24th week of pregnancy rises rapidly. Of the three oestrogens—oestradiol, oestrone and oestriol—it is oestriol which is found in large amounts in the urine. The foetal adrenals supply the precursor (Dehydro-epiandrosterone) for the placental elaboration of oestrogens more particularly oestriol and hence the amount of oestriol in the urine serves as an index of the metabolic activity of the foetus.

When the foetus is in distress all the oestrogen fractions in maternal urine fall but the fall in oestriol is most marked. Although there is considerable individual variation consistently low levels of urinary oestriol or a progressive decline in the amount of oestriol excreted indicate a serious degree of placental insufficiency and warn the obstetrician that the foetus is likely to die soon if not already dead. It is difficult to decide accurately the level of oestriol excretion denoting foetal distress. Broadly speaking it may be stated that when urinary oestriol values of about 12.0 mg. per 24 hours or more are found 24-48 hours before delivery, few or no foetal deaths occur. During the last 6 weeks of pregnancy few infants survive that remain in utero for 2 days or more when values of less than 4 mg. per 24 hours are found. In cases of hydatidiform mole no oestriol is usually detectable. Oestriol excretion between 4.0 and 12.0 mg. may represent foetal jeopardy depending on the stage of gestation. Neonatal mortality may occur when the maternal oestriol excretion is between 4 and 9.0 mg. and intra-partum deaths may occur when the levels are between 4 and 7 mgm. per 24 hours. Infants at or near term may be salvaged by terminating the pregnancy in the presence of low values or rapidly falling values. Delivery of some infants could be postponed to achieve greater maturity in complicated pregnancies when frequent oestriol values indicate that intra-uterine death would not occur. Serial determinations are necessary. It is unwise to draw conclusions from a single estimation.

Pregnanediol excretion. Progesterone production as measured by urinary pregnanediol excretion rises throughout pregnancy reaching a maximum in the third trimester from 10 mg. daily at the tenth week to a peak of about 50 mg. at 37th week. Pregnanediol excretion during pregnancy has been utilised by many investigators as an index of placental function. The reports however are conflicting. During early pregnancy pregnanediol excretion has been utilised to prognosticate the outcome in cases of threatened abortion. However normal levels have been found in threatened abortions. In patients with pre-eclampsia, diabetes and accidental haemorrhage levels well below the normal range could be observed if the foetuses were very small or still

born. Very low values may then indicate impending foetal death. It must be realised that the normal range for the different periods of pregnancy varies fairly widely about the average level and hence isolated observations are not of much significance. To be of value a series of daily successive observations have to be made.

Chorionic gonadotrophin. Chorionic gonadotrophin has been used for many years as a test of pregnancy and placental function. It is produced soon after implantation and reaches peak levels at 60th to 70th day of gestation. The titre then falls rapidly reaching a low level by the 90th to 130th day of pregnancy. In the urine 40,000 to 100,000 international units per 24 hours are excreted by the 50th to 70th day. Values outside this range have been shown to indicate abnormalities of pregnancy.

A low titre of chorionic gonadotrophin in the urine or blood in early pregnancy or its absence indicate inadequate placental function or foetal death. An increased excretion has been found in patients with complications of pregnancy such as diabetes, Rh isoimmunisation and toxæmia of pregnancy. The value of chorionic gonadotrophin estimation in the diagnosis and follow-up of cases of vesicular mole is well established. It is generally held that gonadotrophin estimation is usually of more value in the first half of pregnancy and in the latter half oestriol and pregnanediol estimations would seem to be more reliable as an index of placental function.

Diamine Oxidase (histaminase). The assay of diamine oxidase in plasma by using modern sensitive techniques shows promise as an index of placental function. A sharp rise of this enzyme is said to occur in pregnancy from 5 to 6 weeks following the last menstrual period and rapidly reaches a plateau which remains throughout gestation.

In instances of spontaneous abortion and still birth a progressive decrease in enzyme activity is said to occur. Favourable reports on its prognostic value in threatened abortions have been published. In cases of hydatidiform mole and choriocarcinoma plasma diamine oxidase values have been found to be at non-pregnant levels. This suggests that the presence of a foetus is necessary for increased enzyme activity. The advantages imputed to the test are simplicity, speed and sensitivity.

Amnioscopy. The result of placental insufficiency is intra-uterine hypoxia. When the foetus in utero is or has been affected by hypoxia, it usually passes meconium into the liquor where it may indicate an increased hazard of foetal death. The forewaters can be directly

observed by amnioscopy with little risk to mother or baby and the volume and colour of the liquor can be assessed. In cases where amnioscopy reveals scant liquor or liquor heavily stained with meconium fetal hypoxia can be diagnosed with reasonable accuracy. This method is now being employed in many clinics.

Various other methods like fetal electrocardiography, fetal electroencephalography, diagnostic ultra sound help to assess the fetal state in utero. At present the obstetrician practising in areas where such sophisticated techniques are beyond his reach has to depend mainly on his clinical assessment.

ENDOCRINOLOGY IN OBSTETRICS

SUCCESSFUL pregnancy depends on the proper timing and co-ordination of the various facets of the reproductive cycle. Elaborate changes take place during each menstrual cycle which are preparations for fertilisation and conception. There is no doubt that the ultimate control of the reproductive process resides in the hypothalamus and its regulation of the pituitary gland. Recent experiments have shown that there is no nervous connection between the hypothalamus and the anterior lobe of the pituitary. It is therefore presumed that the control of the anterior pituitary is exercised by a humoral mechanism about which little is known. Recently a Gonadotrophin Releasing Factor (GRF) has been identified in the hypothalamus which is responsible for the release of FSH and LH from the anterior Pituitary. This substance is a polypeptide and has very recently been synthesised.

Gonadotrophins are the follicle-stimulating hormone (FSH), luteinizing hormone (LH) also referred to as interstitial cell-stimulating hormone (ICSH) and prolactin or luteotrophin. Prolactin is a protein containing no carbohydrate while FSH and LH are glucoproteins. These gonadotrophins are produced largely by the basophil cells of the anterior pituitary. The follicle stimulating hormone (FSH) secreted by the pituitary begins to stimulate the growth and maturation of a group of Graafian follicles in the ovary. The cells of these maturing follicles secrete oestrogen which helps in the building up of the endometrium, resulting in the proliferative phase. About the twelfth day of the usual menstrual cycle of twenty-eight days, one or two of the Graafian follicles proceed to maturation and ovulation. The luteinizing hormone (LH) liberated by the anterior pituitary is mainly responsible for the process of maturation and ovulation; LH acting synergistically with FSH increases the production of oestrogenic hormone. The increasing concentration of the oestrogenic hormone stimulates the anterior lobe of the pituitary to secrete more LH to alter the FSH-LH relationship. When there is an excess of LH, the follicle ruptures and the development of the corpus luteum begins.

The oestrogen produced by the growing follicle under the influence of stimulation by FSH and LH is 17 beta oestradiol. There are numerous metabolites of 17 beta oestradiol, the most important of which are oestrone and oestriol. The natural oestrogen with the

greatest potency is 17 beta α estradiol : α estriol is the least potent and α estrone is between the two.

The normal values of urinary α estrogen excreted during a normal menstrual cycle are 1-5 μ g/24 hours for α estradiol, 2-15/24 hours for α estrone and 15-30 μ g/24 hours for α estriol. Excretion always gradually increases during the follicular phase with peak excretion occurring at midcycle or about the presumed time of ovulation. The amount excreted then decreases but a secondary smaller peak is manifest midway in the luteal phase before α estrogen excretion finally decreases to minimal levels at the time of menstruation.

After ovulation the theca interna cells become corpus luteum cells and secrete not only α estrogen but also the other ovarian sex steroid progesterone. Progesterone is also produced in the adrenal cortex as part of the synthesis of specific adreno-cortical hormones. Progesterone produced in the body is excreted in the urine as the metabolically inactive metabolite pregnanediol the estimation of which gives reasonable information as to the amount of progesterone produced and metabolised in the body. In the adult female minimum amount of pregnanediol in the order of 2 mg./24 hours are found during the first half of the menstrual cycle which is probably of adrenal origin. After ovulation and corpus luteum formation the amount in the urine increases to 3-4 mg./24 hours. A normally functioning corpus luteum is essential for the establishment of pregnancy. As a result of the combined activity of the α estrogenic hormone and progesterone the endometrium is built up, rendered more vascular and the secretory phase is induced in the glands. The glands become tortuous, the individual cells are tall and columnar in shape and filled with glycogen. The stroma cells take on decidui characteristics and there is increasing fluid between them. The progestational changes simulate that seen in pregnancy towards the end of the cycle. The average life of corpus luteum is about fourteen days and its functional activity is maintained by luteotrophic hormone (LTH), a third pituitary gonadotrophin. This point is however controversial. In the absence of a fertilised ovum the corpus luteum begins to have regressive changes at the end of about two weeks. There is a rapid fall in levels of α estrogen and progesterone. The endometrium retrogresses, vascular changes take place and menstruation begins. If conception occurs the corpus luteum continues to function for some more time.

When fertilisation occurs, it is usually in the fallopian tube. The fertilised ovum is moved down the tube by its peristaltic action. The ovum enters the uterine cavity at the end of about three days having reached the blastocyst stage during transit. The chorionic cells surrounding the blastocyst now begin the process of embedding the

fertilised ovum in the uterine cavity. This process is mainly by direct erosion of the uterine mucosa which is now fully developed into the progestational phase and is also aided by the cytolytic property of the cells. The invasive chorionic cells provide for implantation and the establishment of a circulation for the rapidly growing conceptus. They also begin to produce a new hormone which is present only in pregnancy—the chorionic gonadotrophin. This hormone of embryonic origin maintains corpus luteum function until the developing placenta takes over the production of œstrogen and progesterone.

The Placental Hormones. The placenta plays the dominant role in the hormonal changes observed in human pregnancy. Large quantities of steroid and protein hormones are secreted by the placenta into the maternal and foetal circulation. Therefore it is not surprising that the placental hormones influence the function of endocrine glands of both mother and foetus.

The maintenance of corpus luteum during early pregnancy by large amounts of protein hormones elaborated by the placenta is an example of this type of interaction. There is increasing evidence that steroid precursors produced in maternal and foetal endocrine glands are converted to hormonally active steroids in the placenta and that steroid hormones produced in the placenta are converted to either hormonally active or inactive metabolites in the maternal and foetal organism. Thus an intimate interrelationship between the function of the placenta and that of maternal and foetal endocrine glands is established.

Claims have been made that the placenta secretes a variety of protein hormones including chorionic gonadotrophin (HCG), adreno corticotrophic (ACTH), thyroid stimulating hormone (TSH), growth hormone (HGH) placental lactogenic hormone (HPL) and relaxin. All these are in addition to the steroid hormones.

Chorionic Gonadotrophin. The cytotrophoblast is responsible for the formation of chorionic gonadotrophin. The syncytium is concerned with the production of the steroid hormones—œstrogen and progesterone.

The production of chorionic gonadotrophin by the trophoblast begins soon after implantation and the hormone appears in the blood serum as early as the eighth day after fertilisation. The concentration of the hormone in the serum and urine varies with the duration of pregnancy.

The urinary excretion in the early stages has a constant level of about 5000 I.U. per twenty-four hours. Its excretion rapidly rises to a peak level of 500,000 I.U. per twenty-four hours at the sixtieth to

seventieth day of gestation, followed by a fall to more or less constant levels of about 5000 I.U. per twenty-four hours until parturition. After parturition it rapidly disappears from the urine.

These large amounts of chorionic gonadotrophin are very necessary in the early weeks of pregnancy for they ensure the persistence of the corpus luteum and hence that of its hormone progesterone which is necessary for the proper nidation of the ovum in the early stages. Deficiency of this hormone at this stage may well result in abortion.

Chorionic gonadotrophin is found in considerably higher concentration in maternal blood and tissues than in the blood and tissues of the fœtus. Most biologic tests for pregnancy depend upon large amounts of chorionic gonadotrophin in the blood and urine during gestation. Increased titres of chorionic gonadotrophin may occur in multiple pregnancies as well as in hydatidiform mole and chorio carcinoma.

Oestrogen. During the last decade it has been demonstrated that the fœtus and placenta are intimately associated as far as the metabolism of steroid hormones are concerned. A number of these hormones are manufactured by the placenta and secreted to the fœtus where they may be metabolised and modified before being returned to the placenta for transfer to the maternal circulation and subsequent further metabolism or excretion. Further, compounds produced in the fœtal endocrine glands such as dehydro-epiandrosterone sulphate (DHAS) from the fœtal adrenal glands act as precursors from which other compounds are synthesised by the placenta. This is particularly true of œstriol synthesis. This compound is manufactured in part in the placenta from DHAS obtained from the fœtus. For the large amount of œstriol excreted in the urine in pregnancy the fœtal adrenal is necessary as it supplies the precursor. Originally it was thought that the increased production of œstrogens in pregnancy was due to their formation by the placenta and the maternal organism. The concept of involvement in this process and therefore of a fœto-placental unit is of recent origin.

During pregnancy increasing amounts of œstrogens are excreted in the maternal urine. The three so-called, classical œstrogens studied extensively in the urine are œstrone, œstradiol 17 beta and œstriol. The levels of œstrone and œstradiol are 2-4 times higher in maternal than in fœtal blood but œstriol is present in much higher concentration in the latter. These levels do not however depend on fœtal œstrogen synthesis but rather on the maintenance of adequate placental circulation by the fœtus.

The placenta produces all the three œstrogens but it manufactures œstriol in largest amount. Perfusion experiments have demonstrated

that DHAS is a precursor in oestrogen synthesis. High concentration of DHAS have been found in cord blood supporting the suggestion that this oestrogen precursor may be produced in the foetal adrenals. The DHAS which reaches the placenta via the umbilical circulation is converted to urinary oestrogen. It has also been demonstrated that combined activities of the foetus and placenta convert non-oestrogenic steroids to oestrogens and this is an important source of oestrogen in pregnancy. Available evidence indicates that oestriol is manufactured by the placenta from both maternal and foetal precursors.

As a result of the active part played by the foetal adrenals in supplying the precursor (DHAS) for the placental elaboration of oestrogen the measurement of oestrogen in the urine has provided a useful method for measuring foetal viability. Since maternal DHAS contributes a relatively minor proportion of the total oestriol throughout pregnancy the measurement of oestriol would seem to offer the best index of foetal welfare. With an anencephalic foetus the urinary excretion of oestriol is only about one-tenth of that in normal pregnancy because anencephaly is associated with a marked atrophy of foetal adrenals which are therefore not capable of producing the precursor DHAS. Maternal oestriol excretion has also been shown to correlate with the baby's weight. The larger the placenta or the baby the higher is the level of oestriol excretion. In early pregnancy the levels of all three oestrogens continue to rise slowly after the middle of the luteal phase instead of falling off as they do before menstruation. About the seventh week there is an abrupt increase in oestrogen levels and thereafter it follows a smooth curve, flattening out towards the end of pregnancy. At term the oestradiol level lies between 0.3 to 0.9 mg./24 hours and oestrone between 0.9 to 2.1 mgm./24 hours and oestriol between 21-41 mgm./24 hours. These are very much higher than the values obtainable in the luteal phase. There does not seem to be any significant alteration in values during late pregnancy and at onset of labour. Following delivery there is a rapid decrease in urinary oestrogen levels.

In pregnancy the oestrogens are primarily responsible for the growth of the uterine musculature. They stimulate hypertrophy of the muscle cells. They help in maintaining the vascularity of the uterus which again is essential for growth. They sensitise the uterine musculature to the action of oxytocin and are responsible for stimulating the growth of the breast.

Progesterone—the hormone of the corpus luteum—is also synthesised by the placenta. It plays a dominant role in the preparation of the uterus for implantation of the fertilised ovum and maintenance of pregnancy in the early months. In the last trimester of pregnancy it

is estimated that about 250 mgm. of the hormone is produced daily. The amount of Progesterone produced varies with the duration of pregnancy. In normal pregnant women there is a gradual average increase in urinary excretion of pregnanediol from 10 mg. daily at the 10th week to a peak of 50 mg. daily about the 37th week and thereafter there is a slight fall. However the normal range varies widely.

In early pregnancy the corpus luteum is the most important source of progesterone. After the sixtieth day the gland can however be removed without interrupting pregnancy in most cases. This is because the placenta is capable of taking over the production of the essential ovarian hormones at an early period of gestation.

There is strong evidence that the placenta begins to produce progesterone by the tenth week of pregnancy or even at an earlier date. Progesterone itself is not excreted in urine. It is excreted as Pregnanediol which is a metabolised product of the hormone. During the first six to eight weeks the Pregnanediol excretion remains at a level comparable with that present at the peak of the corpus luteum phase of the normal menstrual cycle ranging between 6 and 15 mgm./24 hours. Thereafter the excretion rises steadily reaching the highest value about the thirty-eighth week of gestation, i.e., 60-80 mgm./24 hours. There are some variations in the absolute values reported depending on the methods used for estimation.

The urinary pregnanediol excretion is only slightly reduced after interruption of the foeto-placental circulation at mid-pregnancy, in women with anencephalic monsters and in intra-uterine foetal death. It therefore seems probable that the majority of placental progesterone arises from a maternal rather than a foetal precursor. Hence estimation of pregnanediol levels in pregnancy may be more useful in assessing placental function rather than foetal viability.

This hormone is partly responsible for the controlled transport of the fertilised ovum to the uterine cavity and for the preparation of the uterine mucosa to provide the necessary nutrition for the embedded ovum. It accentuates the vascular effects of oestrogens by inducing further growth and coiling of the spiral arteries, thus increasing the blood supply to the endometrium. It is largely responsible for the development of the decidua.

On uterine mortality, its action is controversial. Progesterone is said to inhibit contraction of the uterine muscle by blocking the conduction of the stimulus to contraction. Contrary opinion holds that Progesterone is not a uterine sedative. Some believe that on a quiescent uterus Progesterone has a sedative effect, but on one which is

already acting, as in abortion, its sedative effect is doubtful. The growth of the breasts during pregnancy is largely under the influence of both steroid hormones—Oestrogen and Progesterone. Oestrogen stimulates the proliferation of the duct system and its growth and pigmentation of the nipples and areola. The development of the alveoli and lobules is influenced by Progesterone. This effect of Progesterone can be elicited only in breasts previously subjected to Oestrogen stimulation.

Corticosteroids. There is good evidence that the production of corticosteroids increases during pregnancy and this poses the question whether the secretion arises from the placenta or the fœtus or both. Increased blood levels of cortisol in pregnancy and increased urinary levels of 'corticosteroids' have been reported. It is still not clear whether higher plasma and urinary levels reflect greater production of these hormones or whether they are due to changes in metabolic processes rather than to an increase in synthesis. It is known that the fœtus produces corticosteroids in pregnancy. It is capable of converting a part at least of the large amount of progesterone which it receives from the placenta via the umbilical cord to manufacture its own corticosteroids in the adrenal gland. Some of these steroids are probably returned to the mother and the rest are excreted by the fœtal kidney via the fœtal urine into the amniotic sac. There is no direct evidence indicating production of adreno-corticoids by the placenta.

The urinary excretion of gluco-corticoids, which influence carbohydrate metabolism, increases considerably with advancing pregnancy, reaching the peak during the last trimester. Two to four days after delivery the excretion returns to normal. The same is true of the crude total corticosteroids.

Aldosterone. This is the salt retaining hormone of the adrenal cortex and concerned with electrolyte balance. It has been reported that there is a progressive increase in the urinary excretion of aldosterone during normal pregnancy, followed by a rapid decrease after parturition. This steroid has to do with sodium retention, potassium excretion and hypertension as well as perhaps other electrolyte shifts. There are reports of Aldosterone activity in the placenta of women with pregnancy toxæmia.

It has been suggested that there is an increased demand for adrenal cortical hormones during pregnancy. The only signs of hypercorticalism present in normal pregnancy are eosinopenia and possibly a decreased glucose tolerance. The development of striae gravidarum has been attributed to the action of corticosteroids, but this has not been clearly established.

Pituitary Hormones. The pituitary gland consists of two lobes, an anterior and posterior, and the pars nervosa. The anterior lobe (adenohypophysis) elaborates many hormones. To mention some

- (1) Follicle stimulating hormone (FSH)
- (2) Leutenising hormone (LH)
- (3) Luteotrophic hormone (LTH)
- (4) Adreno-corticotrophic hormone (ACTH)
- (5) Thyrotrophic hormone and
- (6) the growth producing hormone.

The action and function of FSH, LH and LTH and ACTH have already been briefly discussed. When pregnancy occurs the rhythmicity of gonadotrophin secretion is interrupted and no further ovulation occurs. The pituitary begins to enlarge and appears more vascular.

Oxytocin and Vasopressin. From the posterior lobe of the pituitary are produced a group of hormones having oxytocic activity, a pressor effect on blood pressure and an antidiuretic activity. On fractionation of the extracts of posterior lobe two hormone substances have been obtained—oxytocin and vasopressin (anti-diuretic hormone).

Oxytocin. This hormone stimulates uterine contractions and produces ejection of milk from the breast during lactation. During pregnancy the uterus is less sensitive to the action of oxytocin but at term and after delivery it responds strongly to injections of oxytocin.

Vasopressin (Antidiuretic Hormone). The most important characteristic action of this hormone is its antidiuretic activity. The vasopressor effect is more pharmacologic than physiologic and the purified extract has only a slight oxytocic activity. It stimulates the renal tubules to re-absorb fluids, whose osmotic pressure is less than that of the serum. There is said to be an increase of the antidiuretic hormone in pregnancy.

Thyroid Hormone. The thyroid gland synthesises two hormones—thyroxine and tri-iodothyroxine. One of the most important functions of the thyroid hormone is to increase the rate of oxygenation of tissue cells.

There is a progressive increase in the oxygen consumption in pregnancy as indicated by rising values of the basal metabolic rate upto 25 per cent. There is an increase in the Protein Bound Iodine (PBI) ranging from 6.2-11.2 gamma/100 ml. in contrast to 4.3-6.9 gamma/100 ml. in normal control. Increased levels are evident from as early

as the third to the sixth week. Despite these high levels, no signs of hyperthyroidism are present in pregnancy.

The Use of Steroid Hormones in Obstetrics. The use of hormones in obstetrics, is very limited.

Because of its stimulating action on the uterine muscle it was thought that œstrogens might be very useful in initiating and promoting uterine contractions. Oestrogen was therefore used in induction of labour and in cases of hypotonic inertia. In actual practice, it has been a failure and it is seldom employed.

In cases of intra-uterine death and missed abortion œstrogens are said to be more successful in inducing uterine action. 20-30 mgm. of stilbœsterol for four or five days or injections of 10 mgm. of œstradiol Benzoate twice a day for two days are said to be helpful in aiding spontaneous evacuation of the uterus. Opinions regarding dosage and its efficacy are widely variant.

Progesterone. Its only use would seem to be in cases of habitual abortion wherein hormonal studies show a deficiency of this hormone. It has been however used by many on empirical basis in cases of threatened abortions, with the hope that the sedative action of the hormone on the uterus may prevent an abortion. The results of such treatment are not convincing.

In cases of habitual abortion, many recommend commencing injections of progesterone soon after a missed period. Large doses are recommended—125 mgm. weekly, till about the 32nd week. Various varieties of the drug are available—the long-acting ones and the short-acting ones. In cases of threatened abortion, large doses will have to be employed, if any success is to be achieved.

Oestrogens and progesterone have been employed by some in the management of diabetes complicating pregnancy. Here also there is no agreement on its efficacy.

Oxytocics in Obstetrics

Oxytocics are substances which have a definite action on the uterine muscle enhancing its contractions. As such they are of great use in obstetrics. The common oxytocics used are :—

1. *Posterior Pituitary Hormone—Pituitrin.* The crude hormone, Pituitrin (Pitressin) contains both factors—Oxytocin and Vasopressin. The purified extract is pitocin and even this contains a small amount of vasopressin.

2. *The ergot group of alkaloids.*

The two oxytocic drugs employed are—oxytocin (pitocin or the synthetic syntocinon) and the purified alkaloids from ergot-ergometrine or methergine. Oxytocin is used in induction of labour, in the management of hyaline inertia during labour, and in controlling post-partum hæmorrhage. Ergometrine or methergine on the other hand is employed only after the delivery of the child to hasten separation of placenta and control of post-partum hæmorrhage. It is also employed in the management of abortions. Ergometrine and methergine are very powerful oxytocics and their administration gives rise to marked contraction and retraction of the uterine musculature which may last even for an hour and are therefore unsuitable and unsafe for use in pregnancy or labour. If used inadvertently it may result in foetal death and sometimes even rupture of the uterus. Hence its main use is in the control of post-partum hæmorrhage when it can be administered intra-muscularly, intravenously or directly into the uterine musculature (0.25-0.5 mgm.) is the usual dose employed. If administered before delivery of the placenta it may on rare occasions give rise to hour glass contraction of the uterus and retention of placenta. The action of oxytocin is less prolonged—15-20 minutes and the contractions produced by it in doses and methods now employed resemble closely normal uterine activity in labour. The mode of use and indication for its use have already been discussed under induction of labour.

These drugs—Methergine and oxytocin—can also be employed after evacuation of a pregnant uterus in cases of inevitable abortion and vesicular mole and also in the puerperium.

Oxytocin must not be administered in the presence of obstruction to delivery either due to disproportion, malpresentations tumours or rigid cervix. Grand multiparity is considered by some as a contra-indication as also previous cæsarean section scar on the uterus for its use in pregnancy and labour.

RADIOLOGY IN OBSTETRICS

Radiation has its hazards. Even though small, the following hazards should be borne in mind—(1) There is the danger that X-rays may interfere with the development of the early embryo and give rise to congenital malformation if the mother is exposed to radiation in the first trimester. It is advisable therefore to avoid radiological examination particularly of the abdomen and pelvis of the mother in early pregnancy if possible.

(2) Genetic damage—X-rays may interfere with the chromosomes both of the ovary and the foetal gonads. Once derangement of the chromosome pattern occurs it may be reproduced in all succeeding generations. Such abnormal mutations in the off-spring will certainly be harmful.

(3) X-rays and neoplastic disease—Stewart has shown that nearly twice as many children are likely to die from malignant disease before the age of ten if they have been exposed to diagnostic radiation while in utero. However the order of risk is quite small.

Appreciation of these hazards has considerably restricted the use of radiology in modern obstetrics.

Radiology helps in the diagnosis of (1) presentation and position of the foetus, (2) congenital abnormalities—like hydrocephalous and anencephalous, (3) Intrauterine death of the foetus, (4) Multiple pregnancy, (5) Location of the placenta, (6) Assessment of the pelvis—pelvimetry, (7) The size of the foetal head—cephalometry, (8) Maturity of the foetus, (9) Advanced extra uterine gestation and vesicular mole.

In a radiograph, in cases of hydrocephalus, the foetal head is large in comparison with the size of the foetal body. In addition, there is a characteristic forward bulging of the brow. Occasionally, the abnormally wide sutures are seen. If a normal foetus presents by the breech and a radiograph is taken with the woman in the dorsal position, the foetal head shadow will appear magnified out of proportion, as the foetal head is nearer to the X-ray tube than are the foetal body and maternal pelvis. A wrong diagnosis of hydrocephalus may then be made. This can be avoided by taking a lateral or postero-anterior radiograph.

Foetal maturity. In some cases radiographs may help to determine the period of gestation. The data on which the conclusion is arrived

at are (i) the general appearance of the fœtus (ii) the stage of ossification of the bones and (iii) the size of the fœtal skull. The centres of ossification which may be useful are:—The cuboid 36th to 40th week; upper tibia 40th week; os calcis 21st to 29th week. These accepted dates are only averages and hence much reliance cannot be placed on these findings. The ossific centre of the cuboid is one on which some reliance is usually placed.

Intra-uterine death of the fœtus. Over-riding of the cranial bones is the chief diagnostic sign ascertained by the radiograph. This is known as Spalding's sign. Its presence before the onset of labour is a reliable indication of fœtal death; a negative finding does not exclude fœtal death. Always clinical findings must be correlated with the radiological findings before a final opinion is given. Other appearances of fœtal death are: (i) pronounced spinal angulation with an accentuation of the lumbo-sacral curve, (ii) collapse of the thoracic cage which occurs only in advanced stages of maceration, (iii) appearance of the fœtus as if rolled up into a ball, and (iv) in some cases of death, it is possible to demonstrate the presence of gas (nitrogen) in the fœtal circulation.

Vesicular mole. By injection of radio-opaque fluid into the enlarged uterine cavity per abdomen and taking a radiograph within a few minutes, the vesicles can be clearly demonstrated in cases of vesicular mole. Such a procedure sometimes results in the expulsion of the uterine contents and should not be employed if a live normal pregnancy is suspected.

Extra-uterine gestation. If, on a lateral radiograph, no uterine wall is seen round the fœtus, 'extra-uterine gestation' may be suspected. An asymmetrical or unusually high position of the fœtus in the abdomen also suggests extra-uterine gestation. In select cases hystero-salpingography will help to clinch the diagnosis.

Location of the placenta.

(i) **Amniography.** By this method the limits of the amniotic cavity are demarcated by the injection into it through the anterior abdominal wall, of a radio-opaque substance. The placental site in favourable cases is demonstrated as a filling defect on the uterine wall. The recognition of the placenta depends upon (a) the unevenness of its surface and (b) its thickness. This unevenness is transferred to the line of the shadow of the amnion, and affords a simple method of determining the position of the placenta. The more the placenta is curved, the more accentuated does the irregularity become. Hence, in cases of placenta prævia, where the placenta lies in the lower pole of

the uterus, the outline of the shadow abutting on it is greatly broken up and may be completely obliterated.

There is one serious objection, however, to the practical application of amniography. The injection of radio-opaque fluid into the amniotic cavity undoubtedly induces labour in about 60 per cent of cases and cannot therefore be used with any degree of safety to the fœtus.

(ii) **Cystography.** A radio-opaque solution, 12½ per cent sodium iodide, is injected per urethra into the bladder. When a skiagram is taken, the outline of the bladder and the fœtus can be easily made out and the diagnosis is based upon the relation between the contour of the head of the fœtus in cephalic presentations and the shadow of the urinary bladder which is rendered opaque by means of the injection of the contrast medium. In all cases the contour of the fœtal head in the lower uterine segment is almost continuous with the shadow of the bladder in the last three months of normal pregnancy, whereas a free space caused by the placenta separates the fœtal head from the shadow of the bladder in cases of placenta prævia. This method is generally of diagnostic value if the pregnancy has gone beyond the thirty-second week. The space between the contour of the fœtal head and the shadow of the bladder should be more than 1 cm. in width, at least to have diagnostic significance. Separation of the cephalic and vesical shadows by a placenta prævia takes place regardless of the point of insertion of the latter on the anterior or posterior aspect of the lower uterine segment. The method has no value in the differential diagnosis of grave detachments of normally inserted placenta and in placenta prævia, if the fœtus is not presenting by the cephalic pole. Instead of radio-opaque fluid, air can be injected into the bladder as a contrast media.

(iii) **Soft Tissue Radiography.** *Direct placentography.* By 'soft tissue' radiography in the hands of an experienced radiologist, the position of the placenta can be identified correctly in over 90 per cent of cases.

This method of soft tissue radiography makes use of the fact that in lateral radiographs by this technique it is possible to see in profile the greater part of the uterine wall. In favourable cases, the following structures can be identified: (1) the anterior abdominal wall composed of skin and muscle, (2) the anterior wall of the uterus and (3) the subcutaneous fat of the fœtus. From the point of view of diagnosing the position of the placenta, the space between the anterior wall of the uterus and the subcutaneous fat of the fœtus is the important factor. A sudden change in thickness in this space would be suggestive of the location of the placenta.

(iv) **Fœtal Displacement.** If the head is engaged in the brim, placenta prævia of any serious degree is excluded and therefore there is no necessity for a radiological examination ; not so in cases where the head is high above.

If a normal woman, with an empty bladder, is X-rayed in standing position, the fœtal head will be seen to lie in close proximity to the symphysis. Sometimes it will be in close proximity to the sacral promontory. If, however, the fœtal head is seen to be persistently displaced and especially if it is also displaced in a lateral direction, the presence of placenta prævia is highly probable.

At present, in the diagnosis of placenta prævia, the soft tissue radiography is almost always employed.

More recently a variety of radioactive substances have been employed in clinical practice. A substance labelled with a radioactive isotope is injected intravenously. The level of radiation over the uterus is then measured and compared with counts obtained over the præcordium, the assumption being that the most vascular area,—the placenta—will be the one showing maximum radiation. Scanning and photographic procedures provide permanent visual records. Various isotopes have been used— ^{131}I , Iodinated human serum albumin, chromium 51 and others. The advantage claimed for the isotope techniques are their relative simplicity and their low dose of radiation.

Arterial placentography is another accurate method of localisation of the placenta. A fine catheter is threaded up the femoral artery to the point just above the aortic bifurcation and radio-opaque contrast material injected. A single film taken in the lateral position locates the placenta accurately.

Ultrasonic methods are now being employed for the location of the placenta with considerable accuracy.

The value of radiography in the study of the pelvis and the fœtal skull has been dealt with in the chapter on contracted pelvis. Pelvimetry and cephalometry are useful in assessing the possibilities of delivery by the natural passages but in spite of the best efforts, surprises sometimes happen indicating that clinical methods of observation during labour are of paramount importance—probably of more value than the study of the shadows in the X-ray room. Its importance lies in focussing attention to the possible difficulties and thereby getting armed beforehand to enable the obstetrician to give the best suitable artificial assistance in difficult cases.

From these considerations it is obvious that a pregnant woman should not be submitted to radiography for trivial reasons. Radiography, if possible, is best avoided in the first trimester. At the same time, the dangers of radiation hazards need not and should not deter the obstetrician from making use of radiological procedure, if he thinks it will give him valuable information essential for the proper management of the case. Every attempt must be made to reduce the radiation exposure to the minimum. The use of high kilo voltage, high speed screens and films and long tube to film distances will help in reducing the hazards further.

Ultrasonics. Ultrasonic techniques have been used in obstetrics and gynæcology since their introduction in 1958 by Donald and his colleagues in Glasgow. Ultrasound is the name given to sound waves of a frequency greater than the upper audible limit: that is, greater than 16,000 cycles per second. The ultrasound frequencies used in medical diagnosis, however, are some hundred times greater than this so that one is in fact dealing with mega-cycles per second; Donald, for instance, uses $1\frac{1}{2}$ to $2\frac{1}{2}$ megacycles per second to localize the placenta.

Whereas ordinary sound which can be heard is propagated from its source in an outwardly radiating circular fashion, ultrasound can be directed as a beam of light is directed. Like a beam of light, ultrasound can be reflected, refracted or absorbed. Solids and fluids, such as those contained in various body tissues, allow the passage of ultrasound waves although attenuating the waves to a varying extent depending on the consistency of the tissue concerned; each tissue has therefore a specific acoustic impedance. The ultrasound beam is reflected from interfaces between tissues of different specific-acoustic impedance, and so, by suitably displaying the reflected beam, information can be obtained about, for instance, the depth and nature of a swelling under review. As the ultrasound wave is greatly attenuated by air, in medical practice some means of excluding air from between the probe emitting the sound wave and the body surface must be used. This is achieved by applying a layer of oil to the body surface.

The properties of the sound beam requiring mention are:—

- (a) The amplitude expressed in decibels.
- (b) The frequency, expressed in cycles or megacycles per second.

The lower the frequency and the greater the amplitude the greater the penetration of tissue and vice versa. In clinical use, the ultrasound beam is pulsed; Donald usually employs 300 pulses per second each damped to a very short duration of some $1\frac{1}{2}$ to 2 micro-seconds; there is a 3-milli second interval before the next pulse of ultrasound, so that in one hour of scanning there are only two seconds of sound passage.

Ultrasonic techniques may be employed in obstetrics to measure the fetal biparietal diameter ; to recognize multiple pregnancy ; to localize the placenta ; to identify the presence of a hydatidiform mole ; and perhaps, in certain instances, to diagnose ectopic pregnancy and incomplete abortion. In gynæcology its use is principally confined to the distinction between the different forms of gynæcological tumour. The particular fields which appear to hold greatest promise for the future, however, are the measurement of the baby's head (and possibly other diameters of the baby as well) and the localization of the placenta. Various types of sophisticated equipments are now available for use.

ANÆSTHESIA AND ANALGESIA IN LABOUR

THE necessity for relieving the pains of child-birth has been realised for long and different methods adopted for relieving the pains of labour have produced an insistent demand for such alleviation from the mothers.

So far as anæsthesia is concerned, it is required in the majority of obstetric operations both to relieve the patient of the pain of the operation and to help the obstetrician to perform the obstetric procedure with a greater amount of safety for the mother and the child. The methods adopted in obstetric anæsthesia for the performance of operations will be dealt with later. But it is as well to point out that there are two considerations to be borne in mind :—

(1) That the anæsthetic should be a safe one for the woman in labour and should not have any deleterious effect upon the fœtus.

(2) That its use should not cause any complications post-partum, such as atony of the uterus and severe hæmorrhage.

The question of analgesia in labour is on a different footing. With the increased demand from patients the need has arisen for the employment of a safe and certain method of analgesia which, while it will relieve the patients of the actual suffering will not in any way affect the course of labour or the prognosis for the fœtus. A safe analgesic is one that will satisfy the following conditions :—

(1) It should completely relieve the patient of the pains, experienced during the course of labour.

(2) It should not interfere with the progress of labour, i.e., with the force of uterine contractions or their frequency.

(3) It should not increase the necessity for artificial assistance during delivery.

(4) It should not in any manner jeopardise the condition of the fœtus *in utero*.

(5) The child should be born alive without any degree of asphyxia.

(6) There should be no increased risk of post-partum hæmorrhage.

Could these conditions be fulfilled one would advocate the use of such an analgesic in every case, and the labour rooms would be far

more pleasant and comfortable for the patients, the attendant midwives and the obstetricians.

One other factor has also to be borne in mind. The ideal analgesic should be cheap, easily administered and should not necessitate the presence of a medical attendant throughout the course of labour. The practice of obstetrics has still to be largely in the hands of midwives, as it is impossible for the majority of pregnant women to avail themselves of the help of an obstetrician. Such an ideal analgesic has yet to be discovered, and it may be safely stated that at present there is no drug in the market which fulfils all the conditions. It is hoped that, with the increasing interest now evinced in the subject of analgesia in labour, methods may yet be evolved which will go far to satisfy at least most of these requirements.

The various techniques used for analgesia in labour may be classified as under :

- (1) Non-pharmacological methods including placebo.
- (2) Psycho-pharmacological methods.
- (3) Analgesics, sedatives, hypnotics and local analgesia blocks.
- (4) Hypnosis.

(5) Mechanical methods—using appliances of negative pressure or decompression suits—to pull abdominal wall outwards and allow more room for uterus to contract.

1. Non-pharmacological Methods

Natural Child Birth. Grantly Dick Read laid emphasis on training the mother in the antenatal period on physical exercises to relax the muscles involved in labour and lectures to bear with comfort the discomfort of labour. According to him labour is a natural process of child-birth which in uncomplicated cases, could be pleasantly managed if fear and tension are controlled.

2. Psycho-pharmacological Methods. Recently certain phenothiazine group of drugs like chlorpromazine (Largactil 25 mgms.), Promethazine (Phenergan 25 mgms.), Promazine (Sparine 25 mgms.) and tranquilizers like Diazepam (Valium 5-15 mgms.) have been used for their selective action of allaying tension and creating tranquility. They should be administered early in the first stage of labour and are useful in potentiating the sedatives or hypnotics given later in the first stage. Promethazine (25 mgms. I.M.) is better than Chlorpromazine as the latter may inhibit the uterine activity. Diazepam is particularly useful to annul fear and anxiety. It depresses selectively the limbic system without any deleterious effect either on the uterus or the foetus. It may be repeated if necessary when the first stage is

prolonged. Diazepam and promethazine may be supplemented with Pethidine.

3. Sedatives, Analgesics and Hypnotics. These may be administered by either non-inhalational or inhalational methods. Non-inhalational methods are suited for first stage while the inhalational methods are employed for the second and third stages.

4. Non-Inhalational Methods: (i) Chloral and Bromide—Chloral hydrate 15 grs. or 900 mgms. Bromide—30 grs. or 1.5-2 grams. (Triple bromide of potassium sodium and ammonium 10 grains each).

This mixture is given orally early during the first stage when the cervix is only one or two finger's dilated or when the membranes have ruptured early with the mother having only weak ineffective pains. Pleasanter derivatives of chloral hydrate like syrup or tablet of Triclofos are now available which are devoid of side-effects like gastric irritation, nausea and vomiting.

Dose of triclofos—500 mgms.

This mixture of Triclofos alone may be repeated if the first stage is prolonged without deleterious effects on the fœtus or tone of uterine muscle.

(ii) Other drugs like Methyl Pentynol (Oblivon, 250 to 500 mgms.) or glutethamide (Doriden, 500 mgms.) may also be given safely instead of chloral and bromide.

(iii) Barbiturates: Sodium amytal, Quinal barbitone (seconal sodium) Penta Barbitone (Nembutal) are usual preparations given orally. Barbiturates alone are unsatisfactory unless supplemented with Scopolamine (0.2 mgms.) or Pethidine. Barbiturates are specially indicated in Toxæmia of pregnancy, hypertension and epilepsy.

(iv) Opium Alkaloids: Preparations used in obstetrics are Omnopon (20 mgms.), Morphia (15 mgms.) and Heroin (10 mgms.). These are given as intramuscular injections.

Opium alkaloids provide good analgesia even with most resistant mothers. Fœtal depression may easily be counteracted by administration of N. Allyl. Normorphine (Nalorphine) 10 mgms. injected I.V. into the mother just before delivery or 1 to 2 mgms. in the umbilical vein of the baby immediately after birth. They provide not only analgesia but also rest to the mother by increasing the interval between successive pains during which time mother may fall asleep. Opium alkaloids may be combined with Scopolamine for providing twilight sleep.

Pethidine (Synonyms, Demerol, Dolantin) Dose 100 mgms. Of all the drugs used for analgesia, pethidine offers the best results. It may be administered by itself or along with Chlorpromazine, promethazine or Scopolamine for greater depth of analgesia. Pethidine may be repeated when necessary upto a dose of 300 mgms. in three hours. Fœtal depression may easily be reversed by Nalorphine as stated above or by Levallorphan. The availability of the following pharmacologically effective antagonists permit the administration of these sedative analgesic or hypnotic drugs in adequate doses to provide satisfactory analgesia.

1. N. Allyl. Normorphine 10 mgms. I.V. to the mother just before delivery or 1-2 mgms. into umbilical vein of child immediately after birth.
(Nalorphine).
2. Amiphenazole (Daptazole). 30 mgms. I.V. to mother or 3 mgms. into umbilical vein of the child.
3. Levallorphan ... 0.5 to 1 mgm. per every 100 mgms. of Pethidine given to the mother—I.V. to the mother.

All these antagonists counteract fœtal depression without lessening the analgesia.

A scheme of analgesia for the first stage of labour which we have found very satisfactory consists in giving 25 mgms. of chlorpromazine orally when labour pains are well established, followed by 100 mgms. of Pethidine I.M. when cervical dilatation has proceeded beyond 2/5. With this the mothers go into peaceful sleep while uterine action proceeds normally. This dosage provides analgesia for about four hours when a further dose of 100 mgms. of Pethidine may be repeated if required. Small oral doses of chlorpromazine 10 to 25 mgms. may be repeated after eight hours in those in whom analgesia is still not adequate. With this medication amnesia and analgesia was good in 64% of cases, fair in 20% and moderate to poor in 16%. Babies were unaffected and there was no disturbance in uterine activity, although there was an insignificant rise in incidence of assisted or instrumental delivery. If Chlorpromazine is administered before labour pains are well established, the mild pains may be suppressed and labour prolonged. Hence before giving Chlorpromazine one must make sure that cervical dilatation is progressing and strong pains continuing.

Inhalation Methods. Inhalation methods are ideal for second stage of labour.

(1) Chloroform. Though inhalation of chloroform vapour provides satisfactory analgesia, its ill-effects on the myocardium, liver and uterus has precluded its use.

(2) Trichlorethylene (Trilene): In vapour concentration of 0.5% to 1% with air it is the most useful drug for the second stage, safe in all aspects and reliable even when only a midwife is watching the patient. After four hours of intermittent use, the vapour concentration may be reduced to 0.3% to 0.5%. Several inhalers like Cyprane, Freedman's, Tecota Mark 6, Emotril, Airlene etc. have been introduced for self intermittent administration by the mother and all of them offer equally good analgesia. The concentration of vapour in all these inhalers should be adjusted by the anaesthetist or obstetrician for each patient and then left with the mother for self administration. Trilene quickly passes through the placental barrier but without deleterious effect on the infant. Trilene also does not affect the tone of the uterus.

(3) Methoxyflurane-(Penthane): This is also administered like Trilene by specially designed inhalers and a vapour concentration of 0.2 to 0.35% with air provides good analgesia. It is even more potent than Trilene without any adverse effects either on the foetus or uterus or any other tissue in the body.

(4) Nitrous Oxide with air. Since its introduction in obstetrics in 1933, 50% nitrous oxide with air has been very popular for analgesia during second stage of labour. Many types of apparatus like Minnitt (with or without C.M. attachment) Lucy Baldwin, McKesson, are available for intermittent self-administration by the mother. However 50% nitrous oxide in air provides only light analgesia sometimes inadequate when increase in percentage of nitrous oxide or supplementation with small doses of Pethidine may be required. Foetal distress, heart disease in the mother are contra-indications for analgesia with nitrous oxide.

(5) Nitrous Oxide with Oxygen: Recently 50% nitrous oxide—oxygen mixture from pre-mixed cylinders filled with this mixture using Entonox apparatus has been introduced with satisfactory results and witho it ill effects to either the mother or infant.

REGIONAL ANALGESIA FOR LABOUR

Paravertebral blocks of 11th and 12th thoracic intercostal nerves, extradural (lumbar or caudal) and saddle block analgesia are the common types administered for analgesia in labour. These blocks may be made to act longer for six hours or more by continuous administration (continuous extradural method). While a distinct advantage of regional method is absence of foetal depression, a major disadvantage is prolongation of labour.

ANÆSTHESIA FOR OBSTETRIC OPERATIONS

Various types of anæsthesia are employed in obstetric operations depending upon the nature of the operation and complication if any in the mother. The common types employed are (1) intravenous anæsthesia, (2) Inhalation anæsthesia, (3) Regional anæsthesia, (4) Local anæsthesia.

Inhalation Anæsthesia. The following particulars should be remembered before any inhalation anæsthetic is administered to the mother for delivery.

(1) Stomach must be empty to prevent vomiting under anæsthesia and aspiration of vomit into the respiratory tract. During labour, there is a delay in emptying of the stomach and even after six hours stomach contents may be retained. If administration of anæsthesia, while the stomach is full becomes necessary, the stomach must be emptied by introducing a stomach tube before induction of anæsthesia. (Injection of Apomorphine to empty the stomach is not without risks). Any labour ward or an obstetric operation theatre must possess always a suction apparatus in perfect working condition.

(2) If the mother is exhausted due to prolonged labour and dehydrated an intravenous drip must be put up, not only for correction of fluid and electrolyte loss but also for quick I.V. medication when necessary.

(3) Deep anæsthesia with volatile anæsthetic agents may cause :
(a) Fœtal depression, (b) Uterine inertia resulting in post-partum hæmorrhage.

Anæsthetic agents used in Obstetrics. 1. Intravenous anæsthetic agents :

(a) Thiopentone Sodium (Pentothal Na. Intraval Na).

The entire quantity of this drug passes through the placental barrier quickly and hence fœtal depression follows administration within two minutes but after seven minutes the blood concentration falls to insignificant level so that the infant born after seven minutes is safe from any depression. About 200 mgms. may be given for induction of anæsthesia or as a total anæsthetic for delivery of the after-coming head in breech extraction.

2. **Inhalation drugs.** Nitrous oxide, ether, halothane, Methoxyflurane and Trichlorethylene (Trilene) are all used at present with or

without muscle relaxants. As deep anæsthesia with ether relaxes the uterus, ether anæsthesia should be limited to light planes.

3. Halothane : The earlier observation that halothane produces post partum hæmorrhage is not totally correct. If concentration is not exceeded above 1% for maintenance, halothane does not produce atony of the uterus. Hepatic damage occurs only after repeated administration of this drug at short intervals. Proper halothane anæsthesia is ideally suited for obstetrics.

Muscle relaxants : Muscle relaxants of non depolarising group (Tubocurarine, Gallamine) cross the placental barrier but those of depolarising group like Suxamethonium (Scoline) do not pass through and hence safe for the infant.

General Anæsthesia for Cæsarean Section. Premedication consists of only 0.6 mgms. of atropine I.M. one hour before anæsthesia. Choice of technique of anæsthesia depends upon the skill of the anæsthetist. Any of the following techniques may be adopted.

Method 1 : After induction of anæsthesia with ethylchloride, inhalation anæsthesia may be maintained with ether by the open drop method. Maintenance of good airway is essential.

Method 2 : After induction of anæsthesia by intravenous sleep dose of thiopentone, anæsthesia is maintained with nitrous oxide and oxygen with ether, trilene or halothane.

Method 3 : After induction of anæsthesia by intravenous small dose of thiopentone (150 mgms. to 200 mgms.) with 50 mgms. of scoline, the patient is intubated and anæsthesia maintained with nitrous oxide and oxygen with ether or trilene or halothane. The respiration of the mother should be supported until spontaneous respiration is satisfactory.

Method 4 : After induction of anæsthesia with 150 mgms. to 200 mgms. of thiopentone the patient is intubated and anæsthesia is maintained with N_2O and O_2 until the baby is delivered. Then a muscle relaxant (Gallamine 80 mgms. or Tubocurarine 15 mgms.) with pethidine 50 mgms. is given intravenously and anæsthesia maintained with nitrous oxide and oxygen only under controlled respiration.

This last technique is especially indicated when (1) the fœtus is premature (2) fœtal heart is precarious (3) there is a previous history of still births (4) mother is in severe degree of shock (5) mother is suffering from metabolic diseases and toxæmias (6) and there is a previous history of repeated postpartum hæmorrhage.

REGIONAL ANALGESIA IN OBSTETRICS

Spinal analgesia for Cæsarean section : In experienced hands, spinal analgesia is safe for Cæsarean sections. Only small doses of hyperbaric solutions (5 mgms. of Nupercaine i.e. 1 ml. or 50 mgms. of xylocaine i.e. 1 ml.) need be injected in L.3-L.4 interspace. Due to high pressure in the inferior vena cava (160 mm. of water or more) the rise of analgesia is higher in these patients. To prevent hypotension, vasopressors like 45 mgms. of Ephedrine must always be given I.M. and repeated I.V. if blood pressure falls. During the whole period of the operation, the mother should be oxygenated with 100% oxygen and watched carefully for respiratory failure.

Spinal analgesia for cæsarean section should be preferred to inhalation techniques in the presence of (1) Lung complications (2) Uncomplicated diabetes mellitus (3) Previous history of post partum hæmorrhage and (4) Hyperpyrexia in the mother.

Contraindications for spinal are (1) Cardiac disease (2) Obesity (3) Hypertension (4) Shock and toxæmia.

Extradural blocks. These may be administered by either lumbar route or through the sacral hiatus. When prolonged action is required, a catheter may be introduced into the extradural space and repetitive injections of 1% xylocaine made (continuous extradural techniques). They are useful not only for analgesia in the second stage but also for conducting operative procedures for delivery including cæsarean section.

Disadvantages of extradural blocks are :

1. Prolongation of duration of labour, marked increase of instrumental delivery and difficulty of administration.

Local anæsthesia : This method is used both for major obstetric surgery such as cæsarean section and for minor operations—repair of episiotomy and perineal tears and outlet forceps.

It is the method of choice when the general condition of the mother is poor due to cardiac failure, severe shock or any serious illness.

For Cæsarean section using 0.5% Lignocaine (Xylocaine), infiltration is done along the line of incision and layer by layer as the surgeon cuts through. After opening the peritonæum, 10 ml. of the 1% solution is injected into the broad ligament of both sides of the uterus and rest of the operation, can be continued without any further infiltration. This type of anæsthesia has no bad effects on mother or fœtus and does not require the services of a trained anæsthetist.

Paracervical block: This consists of blocking the pelvic plexus in the broad ligament. Needles are introduced for a depth of about 1.5 cms. into the broad ligament approaching lateral to the cervix at 3 O'clock and 9 O'clock positions. About 10 ml. of 1% lignocaine or 0.3% Bupivacaine (Marcaine) is injected on each side.

Pudendal Block. Two methods are employed (1) Transperineal pudendal block (2) Transvaginal pudendal block.

(1) This technique consists in injecting freshly prepared 1% solution of procaine or novocaine in normal saline through a 6" 22 gauge needle inserted through the ischio-rectal fossa to the ischial spine. With the gloved index finger in the rectum as guide, injection is made slowly and aspiration made frequently as the needle advances. After 5 ml. is deposited at the inferior surface of the spine, the needle is advanced until the tip is fairly through the sacrospinal ligament where 5 ml. is injected. The rectal finger is then withdrawn. The needle tip is withdrawn to just beneath the skin, it is then inserted to impinge on the medial surface of the ischial tuberosity where 5-8 ml. is injected. The needle is once more withdrawn to just beneath the skin and the labia on that side infiltrated. The same technique is carried out on the opposite side.

(2) **Transvaginal pudendal block.** The needle with its end protected by the ball of the index finger is introduced into the vagina until the finger presses against the ischial spine. The finger is raised and the needle advanced just posterior and medial to the tip of the spine. After raising a small submucosal wheal the needle is advanced to the sacrospinous ligament which is then infiltrated with 2 to 3 ml. of solution. The needle is then advanced to pierce the ligament and the remainder of the solution is injected after making sure by aspiration to guard against intravascular injection.

Even if the presenting part is on the perineum, injection is possible between contractions. Pudendal block seems close to the ideal second stage anæsthetic for most emotionally stable women. Manual rotation, the use of outlet forceps and episiotomy are possible without appreciable discomfort. It has some disadvantages. The performance requires several minutes and for difficult manœuvres the relief from pain is inadequate and the anæsthesia may wear off before episiotomy repair is completed.

For some time now we have been employing as a routine only pudendal block anæsthesia for vaginal deliveries with very satisfactory results. Even midcavity forceps and breech deliveries can be performed under pudendal block. It has been found very advantageous

to inject 15 mgm. of Chlorpromazine and 100 mgm. of Pethidine in 20 ml. of 5% glucose intravenously slowly prior to the pudendal block. This ensures good premedication and the patients are in a somnolent state. After the delivery is over, they sleep peacefully for some hours. There is no post-anæsthetic vomiting and the recovery is peaceful. Occasionally, there may be a drop in blood pressure.

‘Hypnosis’ has also been successfully used to allay pain in labour and reports are not wanting where even cæsarean section has been done under hypnosis.

SHOCK

SHOCK is a form of acute circulatory failure characterised by a sudden fall in arterial blood pressure, rapidly developing mental torpor, weakness, cold extremities and a rapid and thready pulse, due to withdrawal of the blood from peripheral circulation to the vital organs.

Shock is said to be reversible, when the circulatory failure can be made good by appropriate therapy. When the condition does not improve, but deteriorates progressively, despite adequate therapy, it is known as irreversible shock.

In about 2-3 per cent of obstetric cases shock of sufficient degree to manifest itself clinically is met with. Most cases of shock met with in obstetrics are the result of hæmorrhage and/or trauma and ætiologically at least they are simply manifestations of surgical shock. Placenta prævia, accidental hæmorrhage, postpartum and post-abortion bleeding, ruptured ectopic gestations, ruptured uterus and traumatic delivery may all cause surgical shock. There, however, remains a small group of obstetric complications in which profound shock is manifest without hæmorrhage or trauma. These conditions could be considered as peculiar to obstetrics without any counterpart in medicine and hence the term 'Obstetric Shock' is sometimes used to connote the shock seen in these complications. The complications met with giving rise to such shock are (1) Amniotic fluid embolism, (2) Abruptio placentæ, (3) Inversion of the uterus, (4) Post-partum vasomotor collapse, (5) Supine hypotension syndrome.

1. Amniotic Fluid Embolism. After the membranes have ruptured in the presence of especially strong uterine contractions, there is a possibility that amniotic fluid may enter the open venous sinuses of the placental site, as well as the endocervical veins. This may then enter the general circulation and in this way reach the pulmonary capillaries. Since the amniotic fluid contains matter such as lanugo hair and particles of vernix caseosa and meconium, multiple miliary emboli may reach the lungs. If the degree of vascular occlusion is sufficient, it may result in an excessive load on the right heart with acute dilatation.

Recently the concept has been introduced that such an embolism with liquor amnii is an occasional cause of sudden death during and shortly after labour. The clinical characteristics of this condition are

sudden dyspnœa, cyanosis, pulmonary œdema, and shock, followed by post-partum hæmorrhage. It is observed that, in addition to the severe shock, these cases are frequently associated with failure of the blood to coagulate.

The condition is a very grave one but fortunately rare. It is observed most frequently near the end of the first stage of labour. The syndrome is seen more often in rapid labour with tumultuous uterine contractions and some report increased incidence with oxytocin infusion. Death often occurs suddenly or in a short while.

A highly important feature of most cases of amniotic fluid embolism is fibrinogenopenia. The mechanism is similar to that which occurs in some cases of abruptio placentæ. The profound shock met with in these cases may be due to widespread intravascular clotting with defibrination of the blood.

The accident is almost always 100 per cent fatal. To establish an incontrovertible diagnosis it is necessary to demonstrate amniotic debris in the pulmonary vessels. Oxygen therapy blood transfusion and intravenous administration of fibrinogen are the main lines of management.

2. **Abruptio Placenta.** As stated elsewhere, in cases of severe concealed accidental hæmorrhage, the shock is out of proportion to the hæmorrhage. This is now considered to be due to intravascular coagulation with defibrination of the blood, which inevitably augments the shock due to blood loss.

3. **Inversion of the Uterus.** The vasomotor collapse associated with this rare complication may not be associated with hæmorrhage or trauma. Extreme shock may be the clinical manifestation.

4. **Post-partum Vasomotor Collapse.** Patients with toxæmia occasionally go into shock within a few hours of delivery. It has been shown that the collapse in toxæmia is associated with a low concentration of Sodium and high concentrations of Potassium in the serum. It is similar to that of acute adrenal insufficiency. Shock may also follow a prolonged labour even though the delivery may be natural.

5. **The Supine Hypotension Syndrome.** When pregnant women at or near term are placed in the supine position, acute hypotension associated with increased pulse rate, pallor and sweating may occur as the result of pressure by the enlarged uterus on the inferior vena cava. This type of postural shock is said to occur in some 10 per cent of pregnant women at term, if they lie supine for a period of three to seven minutes. From a practical view point it is important

to know of this type of postural shock, because it can be relieved immediately by turning the patient on her side.

Pathologic Physiology. The common factor in all conditions producing shock is a rapid and severe reduction in cardiac output. The various stages in the development of shock are : (a) initial disturbances, (b) stage of compensation—reversible shock, (c) stage of decompensation—irreversible shock.

(a) *Initial Disturbances.* The low cardiac output is shown clinically by mental and physical weakness, low metabolism and subnormal temperature. The tachycardia and the poor volume pulse again confirm the diminished cardiac output.

(b) *Stage of Compensation—Reversible Shock.* The sudden fall of cardiac output is a threat to the life of the patient. So, a quick redistribution of blood takes place in such a way that tissues like the extremities and splanchnic area, suffer from diminished blood flow, so that the brain may get adequate blood supply at a favourable pressure. This is achieved by widespread vaso-constriction.

(c) *Stage of Decompensation—Irreversible Shock.* The widespread vaso-constriction in the compensated stage is mainly due to constriction of the meta-arterioles and precapillary sphincters. In the irreversible stage this vaso-constriction is replaced by widespread vasodilatation, probably due to extensive vaso-motor paralysis, resulting in capillary stagnation and eventual cessation of blood flow. Possibly many mechanisms are at play. Recently Shorr and his associates have demonstrated the presence of vaso-motor depressor material (VDM) in blood in this irreversible stage, in animals. When such blood is transfused into a healthy animal, it causes a fall in B.P. and diminished response to epinephrine.

Clinical Features. The patient is generally quiet (except in cases of hæmorrhage, when she is restless) and responds feebly but coherently. The skin is pale, cold and clammy. Rectal temperature may be subnormal. The pulse is rapid and weak. Respiration is generally quiet, except in acidosis when it is deep and deliberate.

Hypotension is characteristic of shock, but in the early stages, the B.P. may remain normal due to compensatory vaso-constriction. Urine is diminished, and in severe cases, complete anuria may develop. If the kidneys go to the stage of lower nephron nephrosis, oliguria may be associated with low specific gravity. Blood may show leucocytosis, hæmo-concentration and lowered pH. Potassium may be increased due to increased protein catabolism and impaired renal excretion.

In the later stages of shock, the patient becomes restless, respiration becomes rapid and sighing.

The usual investigations are :—

1. Hæmatocrit reading. The normal being about 45 and every point rise indicating 100 ml. of plasma loss from the system.

2. The blood pressure. Systolic may be about 70 mm. Hg. which shows that the patient is in a severe state of shock and according to Wallace indicates a loss of 2 litres in the blood volume. When the systolic blood pressure is about 50 or 60 mm. of hg., the condition is very grave, and a state of irreversible shock sets in due to cerebral anoxia.

3. Blood Urea.

4. Urinary out-put.

Treatment. (a) Type of transfusion therapy for fluid loss in cases of shock. The fluid lost must be replaced. The ideal in replacement therapy is to give back to the body the exact amount and kind of fluid which has been lost. If it is due to blood loss after severe hæmorrhage, whole blood transfusion is indicated. Where the shock is due to hæmorrhage and whole blood is not available, plasma transfusion has to be started. If neither blood nor plasma is available, the next best substitute will be Plasmosan or Dextran (glucose and saline solutions are not given for replacing blood volume deficiencies).

In the case of intestinal obstruction, the patient requires saline and glucose. If the dehydration is very severe, the patient also loses a little plasma and plasma or whole blood transfusion may be given.

(b) Relief of pain by analgesics. Morphia is the drug of choice in allaying anxiety and controlling the restlessness that occurs in cases of shock. Pain is completely relieved by this form of therapy and thus controls shock. Morphia in doses of $\frac{1}{4}$ gr. is given intramuscularly. When the blood pressure has fallen and the blood circulation is slow, the absorption of this drug, when given intramuscularly or subcutaneously, is retarded and if the drug is repeated, dangerous absorption might occur when the circulation improves. Therefore it is best to give the drug intravenously. When the drug is repeated, one must find out the time that has elapsed after the first dose is given and the condition of the patient. If the patient has no pain, there is no object in depressing respiration by further doses of morphia. If the circulation is good, morphia is given intramuscularly or subcutaneously and it can be repeated every 6 or 8 hours, depending upon the condition of the patient.

(c) The body heat is conserved by covering the patient with blankets and placing hot water bottles. This has been condemned by some, as it produces excessive sweating and fluid loss. This particular form of therapy is beneficial only when it is applied after the transfusion has been started and the blood volume deficiency corrected.

(d) Pressor drugs. Various pressor drugs are available to raise the B.P. Some of them are Methedrine, Percorten, Noradrenaline and Cortisone. The pressor drugs are useful only when the blood volume has been corrected, for they do not increase the cardiac output or increase the capillary flow, though they raise the B.P.

(e) Oxygen therapy is said to be useful in cases of anoxia. Oxygen therapy alone will not be of any use in the treatment of shock.

(f) Position of the Patient. The Trendelenberg position is adopted to favour cerebral circulation. This should not be used when there is any respiratory embarrassment.

The best method of estimating the amount of fluids to be administered is by monitoring the central venous pressure and by estimating the blood volume. By these techniques not only the exact amount can be administered but overloading the circulation with fluids which may be fatal can also be avoided.

Septic shock of endotoxin type. When the state of 'shock' is due to bacterial infection the condition is referred to as 'bacterial' or 'septic shock'. This type of shock is more often found in association with 'septic abortion'. It is less often met with in chorioamnionitis, postpartum endometritis and pyelonephritis.

The culprit is usually a gram negative organism such as *E.coli* or *clostridium welchi*. The factor which produces the shock state is generally believed to be an endotoxin. As a result of endotoxin entering the circulation disseminated intra-vascular coagulation and vasospasm are said to occur. The disseminated fibrin thrombi found in patients dying of septic abortion are identical to that which characterizes the generalised Schwartzman reaction. The pregnant woman like the pregnant laboratory animal is apparently particularly susceptible to this reaction upon exposure to bacterial endotoxin.

Clinical picture. The clinical picture in septic shock is varied. There are two main types and these probably represent the primary (reversible) and secondary (irreversible) stages of the pathophysiologic process. Progression may be rapid or insidious.

Primary shock. In the early phase of primary shock the patient is hypotensive, alert and anxious. She is flushed with an elevated

temperature in the range of 101°—105°F. Rigor may be associated with rising temperature. The pulse rate is raised and urinary output is good. Later the patient becomes pale, cold and clammy, hypotension is marked and temperature becomes subnormal. She becomes gradually less alert. Cardiac output falls and there is oliguria. The triad of hypotension, tachycardia and oliguria is typically present in this phase.

Secondary shock. Secondary shock occurs when measures taken to combat the stasis in the circulation are inadequate. The hypoxia probably damages vessel walls and a secondary phase of vaso-dilatation occurs. This is followed by sequestration of fluid in the extra-vascular space thus reducing the circulating blood volume.

Management. In the management of these cases it is essential to monitor the central venous pressure by cannulisation of an upper arm vein or of the subclavian or external jugular vein. The central venous pressure should be maintained in the range of 8-15 cms. of water. Blood volume estimation is a useful guide to the administration of fluids. Urinary output should be checked hourly. This should be a minimum of 30 ml. per hour. An adequate urinary output is an excellent indicator of the state of the splanchnic bed. Cultures should be taken for bacteriological study and sensitivity tests. Serum electrolytes, arterial pH and blood lactic acid are the most useful of blood chemistry studies. A lactic acid level of 13 mg. per cent usually indicates irreversible shock.

When septic shock occurs in association with a removable septic focus its removal is indicated. Adequate fluid and blood replacement should be carried out using the central venous pressure and the urinary output and blood volume estimation as guides. Blood, plasma or 5 per cent glucose saline should be given as indicated. If metabolic acidosis is progressive sodium bicarbonate should be added to the glucose saline solution.

Antibiotics selected according to the organisms concerned should be given in massive doses intravenously. Penicillin and chloramphenicol are very useful drugs. Penicillin should be given in doses of 10 million units every 3 to 4 hours and chloramphenicol 1 gm. every 6 hours. Corticosteroids should be given—Dexamethasone (3 mg. per kg. body weight) or Methyl predonisolone (15 mg. per kg. body weight) are very useful. These drugs are now given by continuous intravenous infusion and are generally discontinued after 48-72 hours.

Vasomotor drugs may be given as indicated by the state of the patient. In septic shock the aim should be to take all measures neces-

sary to improve tissue perfusion and not just treat the patients' blood pressure. In the primary stage seen more commonly vaso-pressor agents like Metraminol are useful. In the late stage—cold, clammy, hypotensive patient—there is maximal vasoconstriction and vaso-pressor drugs may do harm. When the central venous pressure is elevated and pulse rate is in the normal range isoproterenol (Isuprel) may be used for its inotropic and vasodilator effect. The main danger of this drug is its tendency to produce cardiac arrhythmia and so it should not be used when pulse rate exceeds 120 per minute.

In a patient with septic abortion in the presence of adequate supportive measures it is better to remove the focus within 12 hours. Usually dilatation of cervix and evacuation of the uterus with ovum or ring forceps are adequate. However hysterectomy may have to be considered in cases where the uterine myometrium is involved and is the seat of microabscesses resulting from infected fibrin emboli. Hysterectomy would be indicated if in spite of adequate supporting measures and evacuation, patient continues in shock, the patient is oliguric and chlostridium welchi infection is suspected or proved.

THE CONTROL OF CONCEPTION

ONE of the most acute problems which faces the country is the ever increasing rapid rate of population growth. It is not proposed to go into the demographic and other aspects of population growth except to state that there is universal agreement that the rate of growth has to be curtailed. The population of India in 1961 was 439 million. In 1963 it was 461 million and 550 million by 1970. It is increasing by a conservative estimate by 20 million per annum. The impact of such population growth on the national economy becomes obvious and the necessity for controlling population growth needs no further emphasis.

There are many methods employed for the control of fertility and many factors enter into the choice of the method also. The general attitude of the community (local or national) will make a great deal of difference to the kinds of method that might find acceptance. Methods that would find acceptance under one set of conditions might be impossible under another. It must be remembered that motivation of people towards the acceptance of various methods of family planning are of prime importance. At present there is no such thing as the 'best method' though there may be a 'best method' for a particular couple.

Some of the common methods employed will now be discussed briefly.

(1) *Mechanical and chemical methods of contraception.*

The traditional method of contraception used by the male or female were designed to prevent the entrance of live sperms into the cervical canal. For this to be achieved two conditions must be fulfilled; direct insemination of the cervix during ejaculation must be made impossible and any sperms deposited in the vagina must be immobilised before they can reach the cervix. For the greatest protection therefore two elements should be used: a mechanical barrier protecting the external os and a dose of chemical spermicide in the vagina. The mechanical barrier can be either a condom (sheath, French letter) worn by the male or a cap (diaphragm) worn by the female. The cap must be fitted by a doctor or nurse experienced in the necessary technique and the patient also can be taught to fit it herself.

(2) *Cap-Diaphragm.*

It is important to remember that no cap will fit tightly enough to prevent the passage of spermatozoa into the cervical canal with

certainty in all cases. This method of contraception is therefore not completely reliable without the addition of a chemical spermicide. The most satisfactory spermicides for use with a cap are made in the form of pastes, creams and jellies. The cap should be smeared both inside and outside with the spermicide. The caps are made of rubber or plastic in different shapes each type being made in several different sizes.

(a) *The dutch cap—(diaphragm)*. This type consists of a thin rubber dome attached to a circular metal rubber-covered rim which may be of flat watch spring or a coil of thin wire. The correct size of the diaphragm to be used can be determined by inserting the examining finger into the vagina as far as it will go and noting on the finger the distance from the introitus to the symphysis pubis. This measures the approximate diameter size. The cap is placed with the dome upwards or downwards diagonally across the vagina with the diameter of the rim fitting snugly between the symphysis pubis and the face of the sacrum. The diaphragm is held in position partly by the tension of the spring and partly by the muscles of the vagina. For it to be used effectively however there must be a reasonably intact perineum and good tone in the muscles of the vagina. It cannot be used where the perineum is severely torn or where the degree of cystocele present prevents the rim from remaining in place. The diaphragms are made in sizes ranging from 55 to 100 mm.

(b) *Vault cap—Dumas cap*. This is a suction cap shaped like a circular bowl with a thick rim and a thin centre. The rim clings to the vaginal roof covering the cervix. It is made either of plastic or rubber. A vault cap can be used only in patients with a moderately short cervix—short enough to be completely contained in the bowl. They are made in five sizes—small, medium and large and two more ranging from 50-74 mm. (2-3 in.).

(c) *The Cervical cap*. It is shaped like a thimble with a raised rim and is made of rubber or plastic material. It covers the cervix to its base and the size of the circular rim should fit the circumference of the cervix closely. It is suitable only for cervixes that do not taper. The cervix must be long enough to protrude well into the bowl of the cap. It must be healthy and so situated in the vagina that it is accessible to the patient's fingers. They are also made in different sizes—small, medium, large and extra large.

The cervical and vault caps are independent of the condition of the vaginal outlet while the diaphragm is independent of shapes, position and conditions of the cervix.

The first fitting is usually done by a doctor after a thorough gynaecological examination. Once the decision is made with regard to the

correct size and type of occlusive, it is fitted and the patient is instructed in its use.

Condoms. As in the case of the cap the condom cannot be relied upon to be absolutely safe in all cases. Condoms are usually made of rubber. To lessen risks (from leaking, bursting, slipping etc.) it is recommended that whenever condom is used a chemical spermicide should be inserted into the vagina before coitus.

Chemical spermicides. Many varieties of inexpensive spermicidal preparations are now available. They are harmless and fairly effective. They are easy to use and require no visit to a doctor or nurse. However they have the disadvantage of having to be inserted shortly before coitus. The risk of pregnancy when a chemical alone is used is greater than when combined with a mechanical barrier. Chemical contraceptives are made up in the following forms :—

(a) *Foam tablets*—These dissolve in the presence of moisture with the formation of carbon dioxide foam and release the active spermicide into the vagina.

(b) *Creams, pastes, jellies*—Contained in metal or plastic tubes with screw-on caps—Applicators are available for depositing it in the vagina.

(c) *Aerosols*—These are pastes or creams compressed into strong containers with a gas. The foam is released by pressure on a release valve into an applicator from which it is injected into the vagina.

Other methods. *The safe period or the rhythm method*—Avoidance of coitus during the period of maximum fertility is one of the oldest methods. It is based on the assumption that in a woman with regular cycles ovulation takes place on the 14th day before the onset of the next period and that the ovum if it is not fertilised seldom survives more than 48-72 hours. Therefore if coitus is restricted to the ten days prior to menstruation and the first three or five days after, conception is less likely to occur. As most women do not have completely regular cycles, particularly during the early postnatal months and prior to menopause exact calculation of the date of ovulation is by no means easy and the method is therefore unreliable. Some couples prefer to use this method on religious grounds. Coitus interruptus is another time-worn method which also gives rise to a significant number of failures apart from the stress and strain involved on both parties.

The more modern developments in contraception are two-fold—

(a) The intrauterine device, (b) oral contraceptives. These will now be briefly discussed.

The Intrauterine contraceptive devices (I.U.C.D.). The I.U.C.D. has come into great prominence as a very effective method of preventing conception. For over three decades metal stem pessaries

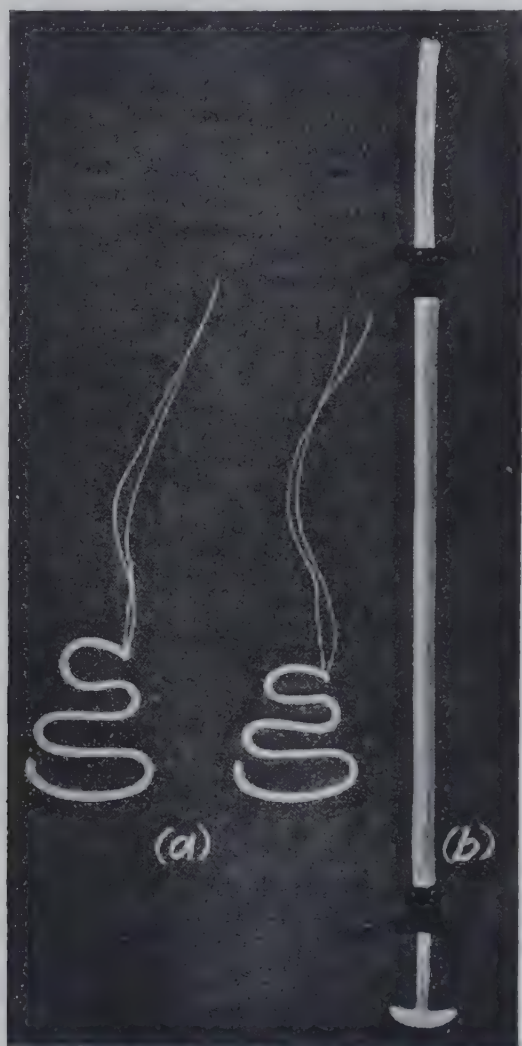


FIG. 168.—Lippe's loop.

in various forms, such as the collar button, the wish bone and others have been in use. Some of them were lodged in the cervical canal and some in the uterine cavity. More than 40 years ago Grafenberg of Berlin used and reported good results with an intrauterine device made entirely of tightly coiled silver or gold wire. However many gynæcologists reported relatively high incidence of pelvic infection, menorrhagia, perforation of the uterus and other complications with its use while very favourable reports also were not wanting. In 1959 Oppenheimer of Israel reported on the use of a four strand silkworm gut ring in 329 women with a pregnancy rate of 2.5 per 100 years of exposure and a minimum occurrence of side effects and complications. At about the same time Ishihama published a report on the Japanese experience in 20,000 cases in which either plastic or metal otarings were employed. His findings were also in agreement with that

of Oppenheimer. Since then several intrauterine devices have been developed and used. Most of them are made out of plastic material and have various configurations—spiral, loop, bow tie etc. The more common ones are the Merguille's spiral, the Lippe's loop and Brinberg bow. It is not proposed to go into detail about each of these except to state that all of them are helpful in preventing conception. The complications vary in their incidence. Of all these, Lippe's loop has been adjudged to be the more useful with minimum complications and this device has been accepted by the Government of India as the device to be employed for control of conception.

The Lippe's loop is a polyethylene device in the shape of a double 'S' with a small polyethylene filament protruding through the cervix to facilitate identification. It is available in three sizes—31 mm., 27.5 mm. and 25 mm. After a complete gynæcological examination

to rule out pelvic infections and other complicating gynaecological disorders the loop is introduced into the uterine cavity with all aseptic precaution.

The loops are kept sterilised by putting them in a solution of 1 in 1000 acriflavine in water or saylon or similar antiseptic for 24 hours. The introducer and plunger provided along with it are sterilised similarly. The loop is fed into the introducer and got ready for insertion. With the patient in lithotomy position and with all aseptic precautions the loaded introducer is inserted into the cervical canal till the guard on the introducer is flush with the external os. With the plunger the loop is pushed out of the introducer into the uterine cavity where it comes to occupy the sagittal plane. The polyethylene filament attached to the loop hangs out of the cervix into the vagina. In parous women it is seldom necessary to dilate the cervix for the insertion. Before insertion the exact position of the uterus should be determined by a careful vaginal examination. No anæsthesia or sedation is necessary. Properly done there is little or no pain. The patient should be taught to feel for the filament in the vagina which would indicate that the loop is in place.

Results of use. All published figures show that I.U.C.D. is among the most effective birth control methods so far developed. The pregnancy rates following its use are about 2-5 per 100 women years of use.

Side effects. Bleeding such as meno-metrorrhagia is reported with varying frequency. Soon after insertion and in the first two or three cycles irregular bleeding and menorrhagia is very common, but their incidence drops considerably after the 3rd cycle. Pelvic pain is most prominent in nullipara. It can be troublesome in a certain number. Other complications encountered are pelvic infection and perforation of the uterus. The latter is said to occur in less than 1 per 1000 insertions.

Expulsion of the loop has proved to be the greatest problem. It is between 3.8 to 17.6%. Our own figure is 8%. Pregnancies have occurred with the loop in situ. However no harm results to the fetus. There is no evidence that the loop is iatrogenic.

Pelvic inflammation, tumours of the uterus and adnexa, dysfunctional uterine bleeding, cervical erosions are contra-indications for the insertion of the loop.

The mechanism of action is yet unknown. Probably the foreign body in the uterus causes such hypermotility of the smooth muscle of the whole internal reproductive tract that the tubes undergo hyperperistalsis and passes the ovum into the uterus either before it is

fertilised or if fertilised in the tube it reaches the uterine cavity before the endometrium is ready to accept it and hence it is not implanted. Attempts are being made to reduce the incidence of bleeding and expulsion rate by altering the size and shape of the intra-uterine devices. So far the ideal I.U.C.D. has not yet been devised. The addition of copper to the I.U.C.D. seems to be more effective in combatting the disadvantages. It is still on trial.

Oral contraception. The ovulation inhibiting effects of progesterone, œstrogen and testosterone have been known since 1934. But it was only in 1955 the value of these steroids as antifertility agents was recognised when Pincus and Rock reported and presented data on ovulation inhibition by progesterone taken orally in the 'cycle day 5 to day 24' regime as well as some preliminary data on the use of norethynodrel as an ovulation inhibitor. In 1956 the first contraceptive field trials using norethynodrel was started in San Juan, Puerto Rico.

Oral contraceptives have been used in two forms combined and sequential. In the former each tablet consisting of a highly potent orally active synthetic œstrogen either ethynyl-œstradiol or mestranol—is combined with an orally active progestogen. Among the latter, compounds of widely varying potency are in use. The tablets are taken daily beginning on the fifth day of a menstrual cycle for 20-22 days and resumed on the fifth day of the subsequent cycle or after seven days. The more recent innovation has been the introduction on inert tablets or tablets containing iron to fill in the gaps so that the patient takes a pill a day continuously which saves the necessity for remembering day 5. This is of particular value to those with poor education. In the usual sequential regimen œstrogen alone is taken for 15 or 16 days beginning on the fifth day of a menstrual cycle and is followed by œstrogen plus progestogen for five days.

Broadly speaking most of the progestational compounds used in oral contraceptives belong to the 19-nortestosterone derivatives group. They include norethisterone, norethynodrel, lynœstrenol and ethynodiol diacetate. The compounds in the group are somewhat œstrogenic probably because they are metabolised to œstrogenic compounds. They are the most powerful ovulation inhibitors and have the most marked hæmostatic effect on uterine bleeding of endocrine origin. Three types of pills are now used in contraception (1) Combination pills containing both œstrogen and progestogens (2) The sequential regimen—œstrogens 14-16 days and progestogen added in the last 5-6 days (3) Progestogens only.

It is not proposed to discuss the pharmacology of these compounds in detail nor to enumerate all the pills that are now available. How-

ever it is observed that during the last few years many pills of the same compounds have been found to be effective in preventing ovulation at much smaller dose levels of the progestogen employed. As a result one finds on the market the so-called mini pills so-called because of the much reduced dosage of the steroids which are at the same time effective.

The mode of action of the pills is mainly by suppressing ovulation. The consensus appears to be that this is brought about by suppressing the L.H. peak which is so essential for ovulation.

Investigations have revealed many alterations in the physiology of those taking the pill. But these alterations are not progressive and are reversible. On stopping the pills they revert to normal values.

Protein bound Iodine and total plasma cortisol levels may be increased. Carbohydrate tolerance may be impaired but oral contraceptives have not been known to hasten the onset of diabetes or increase its severity. Liver function tests show abnormal values; but all these results are reversible as the tests return to normal on stopping the drug.

The ovaries reveal an inactive menopausal like appearance on visual examination. They are small and devoid of corpora lutei. Briefly, the changes in the endometrium (on combined regime) consist of rapid transformation of endometrial glands through the early secretory phase into one resembling secretory exhaustion. The stroma assumes to a varying degree a pre-decidual appearance. On discontinuation of the drug there is a prompt return to normal in one to three months.

Effectiveness. It is customary to calculate the effectiveness of a contraceptive in terms of pregnancy rate per 100 years (1200 months) of use according to the following equation.

$$\text{Pregnancy rate} = \frac{\text{Number of pregnancies} \times 1200}{\text{Patients observed} \times \text{months of exposure}}$$

e.g. if 100 couples have used a method over an average period of 3 years and if 30 pregnancies have resulted the pregnancy rate would

$$\text{be } \frac{30 \times 1200}{100 \times 36} = 10$$

By deducting from the aggregate months of married life those months during which conception was impossible because of pregnancy, separation and the like the duration of exposure to pregnancy can be determined. When the pregnancy rate is below 10 the effectiveness of the method is considered to be high and if more than 20 to be low.

Oral contraceptives have been well tested in clinical trials involving many thousands of cycles and it is firmly established that if taken regularly they have by far the lowest failure rates for all methods of contraception. In the table below is shown the contraceptive failure rates of various methods.

Contraceptive failure rates (rounded figures)

Method	Pregnancies per 100 women years of exposure
Sterilisation	0.02
Oral contraceptives	0.1
I.U.C.D.	2.0
Condoms and diaphragm	15.0
Spermicides, calender rhythm and coitus interruptus	25.0

Side Effects : Minor—The common side reactions which are encountered mostly in the early cycles are nausea, vomiting, break through bleeding, increase in weight, breast tenderness, headache, and increased vaginal discharge.

These are more common in the first cycle and by persistent and continued medication drop to insignificant levels after the third cycle. The incidence of these vary from clinic to clinic depending upon the type of patient and motivation. These range from 0.5-15%.

The majority of the side effects are related to oestrogen/progestogen balance of the tablet. It seems that with experience and with the availability now of a wide choice of compounds which vary in the progestogen/oestrogen ratio the patients' needs in this respect can be assessed and a product can be found to suit her.

Serious side effects. Thrombosis, pulmonary embolism and cerebral thrombosis—There seems to be a casual relationship between the pills and thrombo embolism. The published studies suggest that irrespective of age, the risk of thrombo embolism or cerebral thrombosis is 4-5 times greater in users of oral contraceptives. It is also observed that the risk of death from all complications of pregnancy is 15 times greater than the risk of death from oral contraceptives during 1 year of treatment. The risk of deep vein thrombosis

is increased from 1/20,000 to 1/2000 in women using oral contraceptives. The exact mechanism of production of the complication is not yet known. Both œstrogens and progestogens have been blamed. Oestrogen may cause vasculitis increased coagulability and thrombosis in susceptible individuals possibly by its effects on cortisol binding. However sequential regimen wherein œstrogens are used continuously do not seem to produce increased thromboembolism.

The Committee on safety of drugs in Great Britain have recently issued a statement warning about the increased incidence of thromboembolic disorders in women taking combined œstrogen/progestogen tablets. They have also stated that this incidence is greater if pills containing more than 50 ug of œstrogen are used. The Committee attributes thrombo-embolic disorders to the œstrogen component. The incidence of thrombo embolism in the absence of steroidal contraception shows marked geographical variations. Gynæcologists in India are in general agreement that the incidence of thrombo embolism is much lower than in western countries. It is unfortunate that there are not available statistical data to confirm this impression. What is more important is that the risk from the complication should be assessed against the risks of repeated pregnancies in a country where the obstetric services are poor and where the maternal mortality is still at a rough estimate about 3-4/1000. When compared to this, the risk from taking the pill is negligible indeed.

Oral contraceptives and carcinogenesis. Controversy exists on the role of oral contraceptives in the production of dysplastic changes stimulating cancer, of the generative tract. The present position is that neither the exclusion of a potential carcinogenetic role of oral contraceptives or affirmation of such an effect is justified from available data.

Contraindication. A few rare conditions are known to be aggravated by oral contraceptive administration. These are certain acquired or hereditary defects of hepatic excretory function including Dubin-Johnson and Rotor syndromes. Women who have experienced idiopathic recurrent jaundice of pregnancy redevelop jaundice if given oral gestogens.

Oral contraceptives should be prescribed with caution in those with a history or suspicion of carcinoma of the generative organs and breasts as well as present or past liver disease. In the presence of cardiovascular disease the adverse consequences of sodium and fluid retention have to be considered.

Thrombo embolic disease, varicose veins, cerebrovascular accidents certain ophthalmological manifestations and psychic depressive states may be considered as contraindications.

During lactation high dosage oral contraceptives should be avoided where breast feeding is desired.

There is need for further study of the use of oral contraceptives in women suffering from diabetes, tuberculosis, malnutrition etc.

Asthama, eczema, migrane, rhematoid arthritis, epilepsy and alopæcia may made worse in some women : in others however they may be improved.

Before prescribing an oral contraceptive after taking a detailed history the woman should be submitted to a thorough medical and gynæcological examination including a study of vaginal cytology. A pill can then be prescribed if no contraindications are found. It is possible that the pill prescribed may not quite suit the patient in the first instance. This fact can be ascertained only after its use for a while. If that be so, change to another pill of a different composition often helps.

It is now advised that it is safer to use ' pills ' containing not more than 50 ug. of œstrogen. Such pills now available are (1) Ovulen 50, Norinyl-1, Volidan, Anovlar, Gynovlar, Norlestrin, Ovrал and others. It is also useful to choose the one containing the smallest effective dose of progestogen in addition.

After the pills are stopped conception occurs in about 60% of women in the first three months and in varying percentages in the remainder. There is no increased fertility after stopping the pills nor is there any evidence that any harm is done to the fœtus if conception occurs while taking the pill.

Surgical sterilization of the female. For women who have had sufficient number of children and are anxious not to have any more, tubal sterilisation is one of the best and effective methods. Sterilisation of the woman can be carried out at any time and also as a post partum procedure.

Post partum sterilization. Post partum sterilisation has now become a fairly common procedure where it is considered that further child bearing is inadvisable for various medical reasons and also where the couple having had sufficient number of children are anxious to have no further pregnancies. Before the patient is submitted to operation it is essential to get the consent of both husband and wife in

writing to avoid legal complications and as a safeguard to the surgeon who carries out the operation.

It is customary to perform the operation within the first 72-96 hours of delivery. There are many centres in the world where this operation is performed soon after delivery within the first twelve hours. The uterus during this period is well above the symphysis. In an uncomplicated delivery usually the uterine cavity is from pathogenic organism for the first 48-72 hours. Hence it has been suggested that if the operation is performed within this period chances of infection are less.

Another advantage of post partum sterilisation is that if performed within the first 72 hours of delivery it does not prolong hospital stay unnecessarily.

Post partum sterilization is essentially tubal. Many methods have been described. The aim should be to choose one with maximum success rate. It should be easy of performance and complications resulting therefrom should be either nil or negligible. For long we have employed Pomeroy's technique. It is easy of execution. This fact becomes important particularly when large number of young physicians have to be trained for participation in the National family planning programme. Complications following the operation are negligible but there is a failure rate of about .02%. Tubal sterilisations are not always 100% successful whatever be the technique employed.

Technique—Preparation of the patient is as for any major abdominal surgery. The operation can be carried out under local, spinal or general anæsthesia. The best method is to sedate the patient with good premedication and operate under local infiltration anæsthesia using $\frac{1}{2}$ —1% Novocaine or lignocaine. Over the fundus of the uterus a small longitudinal incision in the middle line is made its length being about 5 cms. After opening the peritoneal cavity the tubes are identified and brought out of the peritoneal cavity by hooking them with the finger. It is essential to identify the tubes by visualising the fimbrial end, else the round ligaments which are anterior to the tubes may be mistaken for the latter and resected. After identifying the tubes it is picked up to form a loop. The base of the loop is tied by a plain catgut suture passed through the meso-salpinx avoiding the blood vessels. The knuckle of the tube so isolated is then cut off. The process is repeated on the other side and abdomen closed. The patient is ambulatory from the next day. In Fig. 4. is shown the subsequent retraction of the cut ends which takes place as soon as the sutures are absorbed. If non absorbable suture material is used such

retraction may not take place, recanalisation is more easy and failure rate may be increased. The over all failure rate in tubal sterilisation using various technique is .0.5%—with Pomeroy's technique it is about 0.2%.

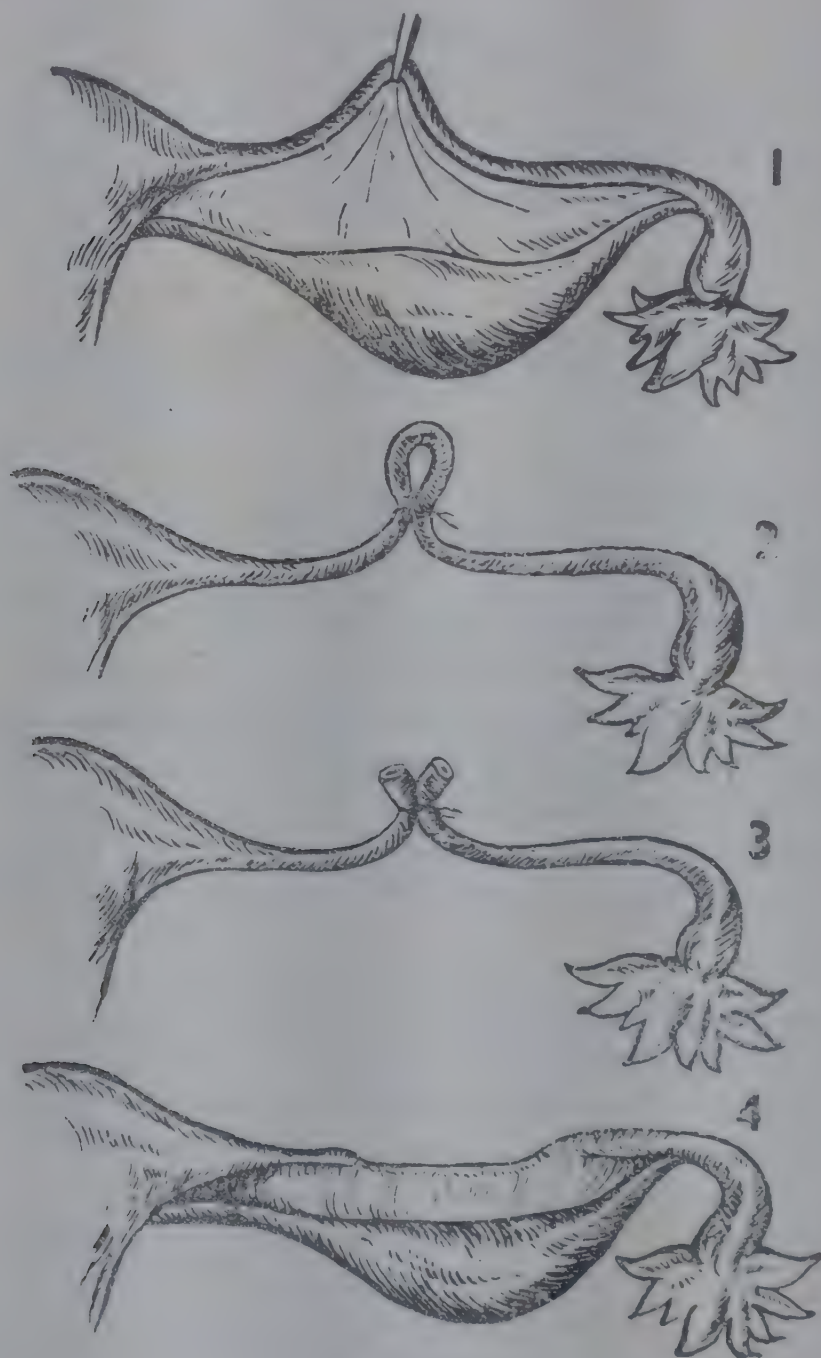


FIG. 169.—1. Picking up a loop of the tube.
 2. The base of the loop is ligatured.
 3. The loop above the ligature is cut off.
 4. The retracted ends after the ligature is absorbed.

There are reports that menstrual disorders obesity and psychological disturbances follow tubal sterilization. Careful studies carried out in many areas do not substantiate this view. Most of these complications have been found in women who are in the age group where

such complications are found even in the absence of sterilization. If cases are properly selected psychological problems also should be rare.

It is now advised that the loop of the tube picked up for sterilization be nearer the cornu so that after resection a fair length of the tube with its fimbria still remains. Should the couple desire another pregnancy there will be then a sufficient length of tube for reimplantation into the uterine cavity.

Tubal sterilization can also be performed per vaginum. This operation is not done as a postpartum procedure. The operation can also be performed through a culdoscope. Abdominal tubal sterilization also can be performed through a laparoscope.

Sterilization of the male. Vasectomy is the procedure employed for sterilizing the husband. It is easier than tubal sterilization and equally effective. Untoward complications are rare.

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